DETERMINANTS OF TECHNICAL EFFICIENCY OF BANKS IN YEMEN

MOHAMED ALI MOHAMED AL-ATTAFI

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DETERMINANTS OF TECHNICAL EFFICIENCY OF BANKS IN YEMEN

By
Mohamed Ali Mohamed Al-Attafi

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ABSTRACT

The main objective of this thesis is to identify the efficiency level and the determinants of efficiency of the Yemeni banks over the period from 1998 to 2011. This thesis consists of three specific objectives. The first objective is to determine the technical, pure technical and scale efficiency score of banks. The second objective is to analyse the differences in efficiency in terms of banks identity, bank type and internationalization of banks. The third objective aims to identify factors that determine efficiency. The two-stage approach which consists of data envelopment analysis (DEA) and Tobit regression is employed in analyzing the data. Specifically, the DEA was used to estimate banking efficiency in the first stage, while the Tobit regression was applied in examining the determinants of the efficiency obtained from the first stage. The results of DEA show that, on average, technical, pure technical and scale efficiencies for all banks over the sample period are 74.5%, 86.3% and 85.5%, respectively. The results also indicate that most Yemeni banks are facing scale problems due to decreasing returns to scale. In addition, the results reveal that there are significant difference in efficiency among banks operating in Yemen based on their identity, bank type and internationalization of banks. Moreover, the results from Tobit regression illustrate that there is a positive relationship between efficiency scores and internationalization of banks, type of banks, intellectual capital performance and gross domestic product, while banks size and profitability have significant negative influence on efficiency. A major contribution that arises from the study is that this is the first study that shows the importance of intellectual capital performance in ensuring banks efficiency especially in Yemen.

Keywords: technical efficiency, pure technical efficiency, scale efficiency, data envelopment analysis, intellectual capital performance

ABSTRAK

Objektif utama tesis ini adalah untuk mengenal pasti tahap kecekapan dan penentu kecekapan bank-bank di Yaman bagi tempoh 1998 hingga 2011. Tesis ini mengandungi tiga objektif khusus. Objektif pertama ialah untuk menentukan skor kecekapan teknikal, skor kecekapan teknikal tulen dan skor kecekapan skala untuk bank-bank. Objektif kedua ialah untuk menganalisis sama ada terdapat perbezaan dalam kecekapan dari segi identiti bank, jenis bank dan pengantarabangsaan bank. Objektif ketiga bertujuan untuk mengenal pasti faktor-faktor yang menentukan kecekapan. Pendekatan dua peringkat yang terdiri daripada analisis penyampulan data (APD) dan regresi *Tobit* digunakan untuk menganalisis data. Secara khususnya, APD digunakan untuk menganggarkan kecekapan perbankan pada peringkat pertama , manakala regresi *Tobit* digunakan dalam meneliti penentu kecekapan yang diperoleh daripada peringkat pertama. Keputusan APD menunjukkan bahawa secara purata, kecekapan teknikal, kecekapan teknikal tulen dan kecekapan skala untuk semua bank dalam tempoh kajian adalah masing-masing 74.5 peratus, 86.3 peratus dan 85.5 peratus. Keputusan juga menunjukkan bahawa kebanyakan bank di Yaman menghadapi masalah skala kerana pulangan berkurangan mengikut skala. Di samping itu, keputusan menunjukkan bahawa terdapat perbezaan yang signifikan dalam kecekapan antara bank-bank yang beroperasi di Yaman berdasarkan identiti bank, jenis bank dan pengantarabangsaan bank. Selain itu, keputusan daripada regresi *Tobit* menunjukkan bahawa terdapat hubungan yang positif antara skor kecekapan dan pengantarabangsaan bank, jenis bank, prestasi modal intelektual dan keluaran dalam negara kasar, manakala saiz bank dan keuntungan mempunyai pengaruh negatif yang ketara terhadap kecekapan. Sumbangan utama yang terhasil dari kajian ini ialah ia merupakan kajian pertama yang menunjukkan kepentingan prestasi modal intelektual dalam menentukan kecekapan bank terutama di Yaman.

Kata kunci: kecekapan teknikal, kecekapan teknikal tulen, kecekapan skala, analisis penyampulan data, prestasi modal intelektual

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

AE	Allocative Efficiency
ATM	Automated Teller Machines
CBY	Central Bank of Yemen
CEE	Capital Employed Efficiency
Crisis	Financial Crisis
CRS	Constant Returns to Scale
DEA	Data Envelopment Analysis
DFA	Distribution-Free Approach
DMUs	Decision Making Units
DRS	Decreasing Returns to Scale
EE	Economic Efficiency
FINCP	Financial Capital
GATS	Agreement on Trade in Services
GCC	Gulf Cooperation Council
GDP	Gross Domestic Product
HCE	Human Capital Efficiency
HIC	Human Intellectual Capital
ICP	Intellectual Capital Performance
IMF	International Monetary Fund
INTSU	Internationalization of Banks
IRS	Increasing Returns to Scale
IT	Information Technology
MENA	Middle East and North Africa
NPL	Non- Performing Loans
PTE	Pure Technical Efficiency
ROA	Return on Assets
ROE	Return on Equity
SCE	Structural Capital Efficiency
SE	Scale Efficiency
SIC	Structural Intellectual Capital
SFA	Stochastic Frontier Approach
TE	Technical Efficiency
TFA	Thick Frontier Approach
TYPE	Type of Banks
VA	Value Added
VAIC	Value Added Intellectual Coefficient
WTO	World Trade Organization
YBRD	Yemen Bank for Reconstruction and Development

CHAPTER ONE
INTRODUCTION

1.1 Introduction

It is widely believed that the banking system is the core of the economic structure of any country, and represents the engine of any development initiative. In addition, it plays a significant role in the growth and development of an economy, as evidenced academically and practically by the literature (Al-Marri, Ahmed & Zairi 2007). Therefore, as the financial institutions and banking system become more effective and stronger, the more roles they play in the economic development through efficient production of products and services (Al-Hajri & Tatnall, 2008). Hence, to carry out this role, each bank needs to be efficient in order to maintain its business successes, given increasing competition in the financial markets, and to contribute to the economy.

Efficiency in economics is a term that describes how well a system performs in producing the maximum output for a given quantity of inputs. If more outputs are produced without altering inputs, or if fewer inputs are used for the same quantity of output produced, efficiency is said to be improved. In the banking industry, efficiency is measured as the difference between the bank's position and its best production frontier. These measures are critical as they enable us to distinguish banks that will survive from those that will not. As such, the present study examines the efficiency of the banking sector in Yemen over the period from 1998 to 2011.

In the realm of globalization, global liberalization of financial markets has resulted in the combined activities of financial institutions (Ragunathan, 1999). Current financial institutions are within an environment characterized as active, dynamic and competitive, urging for the need of financial sector supervisors and financial institutions to review their performance as their survival is dependent on their efficiencies (Reda & Isik, 2006).

The rehabilitation of the Yemeni economy was designed in line with the strategic vision of the political leadership of Yemen and Gulf countries. This integration was done with the countries that belong to the Cooperation Council of the Arab Gulf States, with the aim of giving Yemen extra depth for economic progress and development, to achieve economic integration and ultimately, to strengthen the confidence of the international community up to the regarding Yemen's national economy (Ministry of Planning and International Cooperation Report, 2006).

There is no doubt that these in-depth changes and developments pose a wide-range of challenges for the Arab banks in general, and Yemeni banks in particular, which will have to adapt, and struggle to maintain their position in the banking industry, at local, regional and international levels. Due to this scenario, the importance of assessing the productive efficiency of banks in Yemen has emerged, as the banking system in Yemen is considered as underdeveloped, inefficient and unable to support the rapid pace of development (Al-Swidi & Mahmood, 2011). On a more serious note, Yemenis still do not trust the banking system fully as it lacks a strategic vision to back the developing banking sector and leverage business activities in the region (Al-Swidi & Mahmood,

2011). In addition, it has been documented that about 70 percent of the Yemenis dwell in the rural part of the country and have no knowledge of banking services. In some cases where they have knowledge of the banking system, they do not trust its operations. As a result, the banking system in Yemen is only in possession of 60 percent of the total money supply, while the rest sector of the economy operates with cash (Zolait, Sulaiman & Alwi, 2008).

As argued by Al-Swidi and Mahmood (2011), Yemeni banks lack managerial skills in leveraging business opportunities and skills to respond effectively to the challenging and dynamic business environment. This, in turn, may interpret the modest contribution of Yemeni banks to economic development. Figures 1.1 and 1.2 provide the indicators of absence of participation in the Yemeni banking sector. For example, Figure 1.1 shows that only 31.3 percent firms in Yemen have savings account which is lower than those found in the Middle East, North Africa and also the rest of the world. In terms of firms with bank loans or line of credit, Figure 1.2 shows that only 8.1 percent firms in Yemen use these facilities. This is far below the usage in the Middle East and North African (MENA) countries and the rest of the world. These imply that Yemeni banks are lagging far behind and they need to strengthen their operations in order to face the challenges of globalization, and to contribute to the economic development of Yemen.

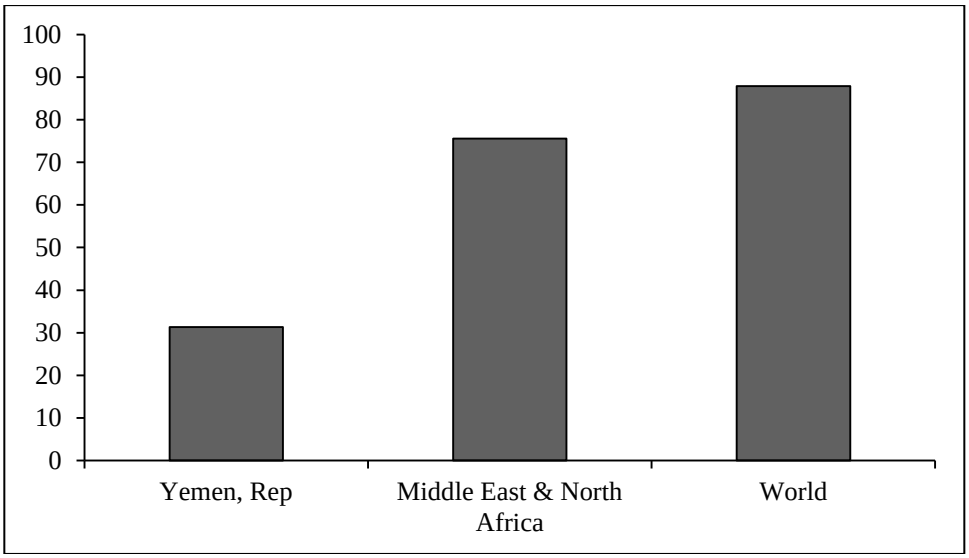

Figure 1.1
Percentage of Firms with a Checking or Savings Account in 2010
Source: World Bank (2012)

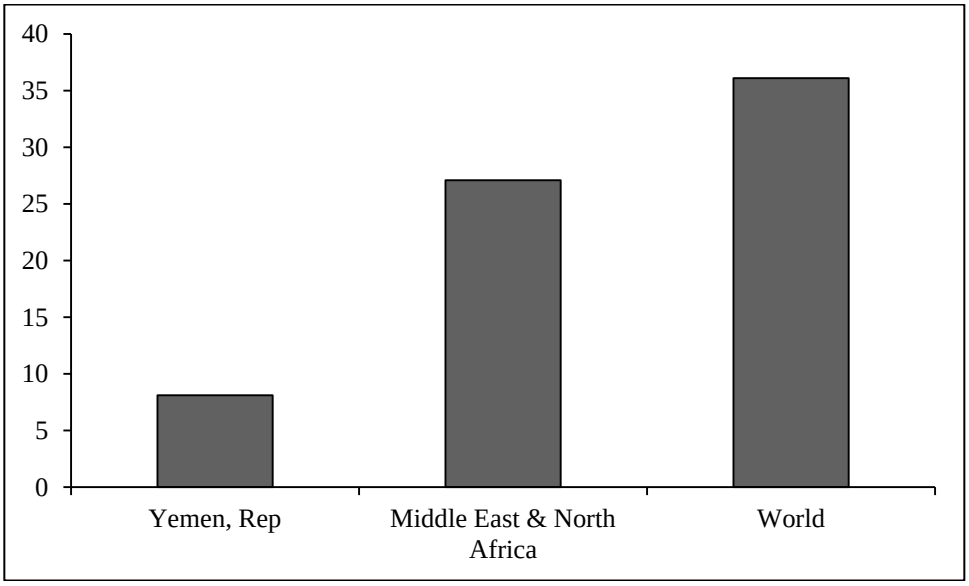

Figure1.2
Percentage of Firms with a Bank Loan/Line of Credit in 2010
Source: World Bank (2012)

Currently, there are two main techniques used to evaluate banking efficiency, i.e., the parametric method, such as the stochastic frontier approach; and the non-parametric method (mainly data envelopment analysis). The debate on which approach is more appropriate for analyzing the efficiency of the banking industry is still open and has been the subject of many applied works (Luciano & Regis, 2007). This study follows the two-stage approach as suggested by Coelli, Roa and Battese (1998). In the first stage, a non-parametric data envelopment analysis (DEA) is used to estimate the three different types of efficiency, namely technical, pure technical and scale efficiencies. Here, labor (salaries), capital (i.e., the value of fixed assets) and deposits (i.e., customers' deposits, call deposits or current accounts) are used as the inputs and loans (i.e., total loans) and investment (i.e., banks' securities, investment funds and stocks) are used as the outputs. In the second stage, the study attempts to find the determinants of banks' efficiency in Yemen. The efficiency score measures derived from the DEA estimations are used as the dependent variable and then regressed upon size, non-performing loans (NPLs), profitability, financial capital, internationalization of bank, type of banks, automated teller machines (ATM) and intellectual capital performance (ICP).

In contrast to previous studies which focused on efficiency of the banking industries in developed and emerging economies, the current study provides an in-depth study of the efficiency of commercial banks in Yemen, which is listed as one of the least developed countries in the world. In Yemen, no such study has been documented previously and therefore, the present research tends to close the current gap in the literature. Moreover, this study also explores the effect of some influential variables which have not been considered before, such as ICP and ATM on organizational performance. The inclusion

of these variables is important because the business environment has become more challenging with rapid advancements in technology. It is hoped that the present study can add to the body of knowledge, comprising the international banking efficiency literature and extend the said literature, which is currently mostly dominated by studies from developed countries (Mostafa, 2009; Mokhtar, AlHabshi & Abdullah, 2006; Yildirim & Philippatos, 2007; Isik & Hassan, 2002; Berger & Humphrey, 1997).

1.2 Background of the Study

The Republic of Yemen is a Middle Eastern country located at the southern part of the Arabian Peninsula. It is surrounded from the south and the west by the Arabian Sea, the Gulf of Aden and the Red Sea. With a total area of 527,970 square kilometers and a coastline of 1,906 kilometers, Yemen is known for its Socotra Island and Kamaran group located at the Indian Ocean and the Red Sea respectively. Its capital, Sana'a, is to the west of the country. Other prominent cities in the country are Aden which is located at the south, Mukalla in the eastern coast and Al-Hodiedah which is located at the Red Sea Coast.

Prior to 1894, there were no proper banks in the Republic. Money exchange agencies were set up to carry out the financial needs of the foreign firms located in the country. In 1894, the Indian National Banks decided to establish its commercial branch in Aden and this led to the existence of the financial market in the country in 1950s (Zolait *et al*., 2008). The Yemen Bank for Reconstruction and Development (YBRD) was the first national bank in Yemen and was established in 1962 as a public company. The bank was

owned by both the private sector and public sector with the ratio of 49:51 paid up capital respectively.

Yemen has been trying for a long time to join the World Trade Organization (WTO) in order to achieve regional and global integration, and to keep pace with the global business changes. The Yemen government has taken part actively in a series of negotiations with the WTO, and is optimistic of getting access to the international body (World Bank, 2010). The government of Yemen is also engaged in promoting Yemen as an environment conducive for investment. If these efforts are successful, it will give way for investors from foreign countries to tap the investment opportunities in Yemen which are currently lacking. The Yemeni government has also initiated reforms of programs on all economic sectors in general since March 1995. In particular, both fiscal and monetary policies have been reformed. This is done with the cooperation of regional organizations, such as the Arab Monetary Fund, and international organizations such as the International Monetary Fund (IMF) and the World Bank. These reforms seek to take advantage of the positive opportunities that arose from the General Agreement on Trade and Services (GATS) (Cook, Hababou & Roberts, 2001).

Besides that, Yemen has also implemented Stand-By Arrangement (SBA) program, Extended Fund Facility (EFF) program and Financial Sector Adjustment Facility (FSAF) program through a number of procedures, policies and mechanisms (Ministry of Planning and International Cooperation Report, 2006). Such mechanisms work in favor of liberalization of prices and privatization, the opening of the Yemeni market to regional and international markets, the liberalization of foreign trade and elimination of

subsidies, and the control of the public sector activities to take a supervisory role on the different sectors. These reforms have gone through two main phases, i.e., Phase I and Phase II. Phase I started from 1995 to 1998 and Phase II started in 1998 and is still ongoing. In this regard, significant achievements have been made in all sectors in general. The programs focused on the restructuring of the economy and the issuance of laws and legislations which aimed to create an enabling environment for investment. In addition, these activities were designed to prepare the economy to achieve sustainable growth and development, and to ensure an improvement in people's lives. The active trading activities in Yemen, due to its attractive location between Asia and Africa, have created the urgent need for the financial institutions' development and enhancement to meet the development of the economic activities in the region.

According to the Central Bank of Yemen (CBY), the Yemeni banking sector has gone through several changes manifested by the increase in the number of banks from 13 banks with 83 branches in 1990 to 18 banks with 246 branches in 2011. A summary of the structure of the banking system is shown in Table 1.1.

The banking system is at the heart of the Yemeni services sector and plays the most important role in the financial system. In 1998, the Yemeni banking system had total assets worth US$ 1.5 billion. This constituted 24 percent of the Gross Domestic Product (GDP) of the country. The average total assets of the Yemeni banking system increased from 24 percent of the GDP between 1998 and 2004 to 28 percent between 2005 and 2011 (Central Bank of Yemen, 2011; 2005). This indicates the increasing contribution made by the banking system to the overall economic development.

Table1.1
List of the Banks in the Yemeni Banking System

List of Banks	Date of Establishment	Shareholders	Percent	Total Branches
Central Bank of Yemen	1971	Government	100	21
Government Bank				
The Yemen Bank for Reconstruction And Development	1962	Government Private	51 49	39
National Bank Of Yemen	1969	Government	100	32
Cooperative & Agricultural Credit Bank	1982	Government Yemeni Corporation	87 13	39
Housing Bank	1977	Government Private	97 3	2
Foreign Banks				
Arab Bank	1972	Jordan	100	10
Caylon Corporate and investment Bank	1975	France	100	5
United Bank LTD	1972	Pakistan	100	2
Rafidain Bank	1982	Iraq	100	1
Commercial and Islamic Banks				
Yemen Kuwait Bank For Trade & Investment	1979	Private	100	8
Yemen Commercial Bank	1993	Private Government	90 10	8
Yemen Gulf Bank	2001	Private	100	2

Table1.1 (Continued)

List of Banks	Date of Establishment	Shareholders	Percent	Total Branches
Shamil Bank Of Yemen & Bahrain	2002	Private	100	4
Islamic Bank Of Yemen for Finance and Investment	1995	Private Government	95.5 4.5	6
Tadhamon International Islamic Bank	1995	Private	100	22
Saba Islamic Bank	1997	Private	100	13
Alkuraimi Islamic microfinance bank	2010	Private	100	87

Source: Central Bank of Yemen (2011); Zolait *et al*. (2008)

1.3 Problem Statement

In an analysis of the economic and social performance of 18 countries of MENA, Yemen was rated as the least efficient of all countries (Ramanathan, 2006). The banking sector in Yemen is not an exception. Al-Swidi and Mahmood (2011) and Zolait, Sulaiman, and Alwi (2008) point out that the banking sector in Yemen faces many problems, such as poor organizational performance, low quality of the introduced financial products and services, lack of customer focus, and lack of banks' entrepreneurial exploitation of new business opportunities. These problems give a clear indication of the absence of efficiency in the Yemeni banking sector and may affect its survival in the long term.

The issues might constitute a threat to the Yemeni banks' survival especially when Yemen enters the WTO, where the competition among the local and foreign banks is always increasing. Hence, greater attention should be paid to measure the efficiency of Yemeni banks and to identify the factors that may enhance efficiency of those banks. This is because an efficient banking system can promote depositors to increase the amount of deposits made, which in turn, can promote monetary advancement and boost national income and wealth (Chan, 2008). Thus, the current study extends previous studies by trying to find out the factors that impact bank efficiency in Yemen.

The examination of efficiency of the banking sector has important policy implications for any Arab state, as the banking industry is a vital part of the financial system of a country. Nevertheless, numerous studies that have assessed the efficiency of the banking system have only been undertaken in the developed countries (Mokhtar *et al*., 2006). Similar studies in developing countries or least developed countries, such as the Republic of Yemen, are relatively rare. In addition, studies examining the determinants of efficiency in the banking structure are still lacking (Iimi, 2004). Therefore, there is a need for studies to analyze the factors which determine the banks' efficiency.

Most research have found that non-performing loans (NPLs) affect efficiency negatively as it reduces the ability of the banks to mobilize their money productively. A higher NPL is a characteristic of failing institutions, and normally, these institutions tend to have low efficiency (Wheelock & Wilson, 1995). Regarding the relationship between efficiency and NPLs, Sufian (2009) and Reda and Isik (2006) find that NPLs affect efficiency negatively. Furthermore, the main stumbling block to the efficient operations

of the banking system in Yemen involves low capitalization (Al-Swidi & Mahmood, 2011). However, the effect of financial capital on efficiency is an empirical issue. Some studies find that capitalization affects efficiency positively (Pasiouras, 2008; Isik & Hassan, 2003). In contrast, Sufian (2009) and Maghyereh (2004) find that financial capital affects efficiency negatively. Thus, it is important to study the relationship between NPLs and financial capital on the efficiency of banks.

Literature in the field of banking asserts that larger firms could be efficient mainly because of their potential to realize optimal output. For a given set of prices, large banks could get higher profits mainly due to their ability to gain size for decades, an achievement which cannot be realized by small banks in the short-term. On the other hand, probably, firms which are more efficient have more effective competition and become large. Berger *et al*. (1993) direct the attention to the point that the positive relations contended between efficiency and size might be obscure in the sense that which leads to which is not straightforward. While Sufian (2009), Reda and Isik (2006) find a positive association between bank size and efficiency, Moussawi and Obeid, (2011) find that they are negatively related. Thus, the current study aims to shed light on the relationship between size and banks' efficiency in Yemen.

It has been argued that clients usually have preference for banks that report higher profitability ratios, thus attracting largest share of deposits and potential borrowers who have better credit worthiness. Those conditions bring about an environment conducive for the profitable banks to perform efficiently from the intermediation activities perspective. However, the effect of profitability on efficiency is a controversial issue. In

this regard, Sufian (2009) and Reda and Isik (2006) find a positive association between profitability and efficiency, while Moussawi and Obeid, (2011) find that they are negatively related. Thus, based on previous empirical evidence, it is important to study whether profitability leads to higher efficiency of banks.

The liberalization policy of the banking sector in Yemen has attracted several foreign banks into the Yemeni market, and this has contributed to the introduction of quality financial products and services. Due to the fact that foreign banks are superior to the local banks with respect to the managerial system, technological systems and international operations activities, the business environment for the banking industry has changed absolutely with the competition becoming more tough and keen (Stiglitz, 1993). However, the effect of technological systems and international operations activities on banks' efficiency is an empirical issue. In their studies, Shao and Lin (2002) and Isik and Hassan (2002) find that technological systems and international operations activities positively affect efficiency. In contrast, Pasiouras (2008) finds that automated teller machine (ATM) does not have a statistical significant impact on efficiency. Also, it is found that international operations in terms of banks operating through branch offices are negatively related to efficiency. Hence, based on the conflicting results of the previous empirical studies, it is important to examine the influence of ATM and internationalization of banks on banks' efficiency, particularly in Yemen.

Commonly, Islamic Banking has become a growing force in global financial circles over the past three decades. In Yemen, there is an increased competition between Islamic banks and conventional banks, whereby in 2010, four Islamic banks managed to get 50

percent of the total market share in the Yemeni banking sector (Al-Saed, 2012). In this regard, Alsarhan (2009) finds significant positive relationship between the Islamic banks and the efficiency score. On the other hand, Mohamad, Hassan and Bader (2009) find that the overall efficiency outcomes of Islamic banks are not significantly different from their conventional counterparts. Thus, based on the empirical issue and the competition between Islamic banks and their counterparts in Yemen, it is important to study whether these types of banks have relationships with efficiency score.

Goh (2005) argues that essentially, banks rely on physical capital for their operations, but the quality of products and services provided by them for their customers eventually depends on intellectual capital (IC). Both human capital and customer capital constitute the most important components of intellectual capital of banks, because banks depend on a huge amount of human capital and customer capital for their survival (Kamath, 2007; Goh, 2005). Therefore, this study attempts to extend prior researches on bank specific factors that affects efficiency in less developed countries by investigating the relationship between bank`s intellectual capital performance and Yemeni bank's efficiency. The result of such finding is expected to serve as a reference for the effects of intellectual capital on banks' efficiency.

1.4 Research Questions

1. What is the technical, pure technical and scale efficiency score of the banking sector in Yemen?
2. What are the differences in efficiency based on banks' identity, bank type and bank internationalization?

3. What is the relationship between bank specific characteristics in terms of bank size, profitability, non-performing loans, financial capital, ATMs, type of banks, internationalization of banks, intellectual capital performance, and the technical, pure technical and scale efficiency score of banks in Yemen?

1.5 Objectives of the Study

1. To determine the technical, pure technical and scale efficiency score of banks operating in Yemen.
2. To investigate whether there are differences in efficiency based on banks' identity, bank type and bank internationalization.
3. To determine the link between certain bank characteristics (bank size, profitability, non-performing loans, financial capital, ATMs, type of banks, internationalization of banks, intellectual capital performance) and technical, pure technical and scale efficiencies of Yemeni banks.

1.6 Significance of the Study

Researches dedicated to the evaluation of banking performance and efficiency are few in the Arab region (Mostafa, 2009). It is evident from the review of studies that most of the studies have been carried out in the West and other regions of the world, while the Arab world has been largely ignored. This lack of research in the Arab world, especially in Yemen, has motivated this research. Moreover, studies on banks' efficiency are important to assist the government to understand and address the factors affecting banks` efficiency.

Generally speaking, a weak economy has been associated with weak financial system. Therefore, it is important that Yemeni banks improve their financial services to support the economic development in the future. Taking this point into account, this study focuses on the efficiency of Yemeni banks, which is the engine of development, as opposed to other sectors in the country. Since banks in Yemen are the main players in the financial services sector, efficiency improvement of Yemeni banks is very crucial to provide a supportive financial infrastructure for economic development. Improvements in banks' efficiency may also minimize the cost of intermediation, which directly affects the intermediation margin in the market, and it may also help to improve the economy.

The determinants of banking efficiency across financial industries have not been a frequent topic of study in the body of literature, especially in least developed countries (Berger & Humphrey, 1997; Mokhtar *et al*., 2006). This current empirical study aims at filling this gap by exploring efficiency in the Yemeni banking sector. The study's regression was done on a set of explanatory variables that have not been simultaneously addressed in the previous studies.

One of the variables is bank internationalization which is rarely investigated especially in least developed countries, such as Yemen. It is important to note that most prior researches in this area only focused on developed and emerging economies. For example Mahajan *et al.* (1996) focused on banks in the USA, Pasiouras (2008) focused on the banking system in Greece, while Isik and Hassan (2002) focused on Turkey. The ability to generalize findings of previous studies to the Yemeni context is questionable because of the significant differences between the Yemeni banking industry and its counterparts

in developed or even in developing countries. This study extends prior researches on the relationship between bank internationalization and Yemeni banks' efficiency. By doing so, this study complements the existing body of knowledge relating to banks' efficiency from a least developed country perspective.

Self-service technology (ATM) is very limited in Yemen, and normally, they are located in big cities. Hence, knowing the relationship between self-service technology and efficiency is vital as it would provide information on the importance of self-service technology in the banking sector. However, only few studies have been conducted on the effect of self-service technology on banking efficiency (Ou *et al*., 2009; Pasiouras, 2008). Hence, this study fills the gap by examining the impact of ATMs on the efficiency of banks in a least developed country, where the banking sector is still lacking in terms of quality of the introduced financial products and services, customer focus and banks' entrepreneurship; and where there is still room for efficiency enhancement through the adoption of technology like ATM (Fernández-Menéndez, López-Sánchez, Rodríguez-Duarte & Sandulli, 2009).

Despite the advantages and challenges, some studies (e.g., Hussien, 2004; Hassan & Bashir, 2003; Samad & Hassan, 2000; Sarker, 1999; Bashir, 1999) propose that Islamic banks are superior to conventional banks. However, the focus of previous studies has been on developed and emerging countries, and it seems that no attention has been paid to least developed countries in general and Yemen in particular. Moreover, the Islamic banking literature is still in its developmental stage especially in MENA (Olson &

Zoubi, 2011). Thus, the findings of the current study contribute to the body of literature on the examination of the link between type of banks and efficiency in Yemen.

In recent years, intellectual capital has greatly become a subject of research in the developed world, with attention being focused on particular industries. Nonetheless, only a handful of researches have paid attention to developing economies to assess the implications of intellectual capital in particular industries (Kamath, 2007). In addition, mixed evidences have been reported on the impact of ICP on performance. Therefore, the present study contributes to the body of literature by presenting a finding on the link between IC and banks efficiency in Yemen which could be generalized to a certain extent. In particular, this study tends to observe if intellectual capital is efficiently utilized by Yemeni banks to their advantage in enhancing their efficiency.

Another significance of this study is the period it covers, i.e., the period from 1998 to 2011, after which the Government of Yemen started the liberalization of the financial and economic system. In this period, the number of banks (including both Islamic and foreign banks) incorporated into a new banking system increased, reflecting the latest changes in the deregulation of banking process and their level of competition.

The analysis of efficiency in the Yemeni banking sector will benefit the policy makers, the consumers and the banks' management to enhance the operating efficiency of the bank. Moreover, the banking efficiency's analysis is invaluable to academicians, analysts and practitioners, as it provides insights into the survival of Yemeni banks in the future. In the future, the Yemeni economy will completely be opened to the rest of

developed countries owing to the globalization and liberalization and hence, Yemeni banks will have a competitive edge.

Increased competition between Islamic banks and conventional banks has resulted in the improvement of Islamic market to achieve a higher performance (Al-Saed, 2012). For example, the Yemen Kuwait Bank for Trade and Investment has 10 percent of the total market of Islamic banking in Yemen in 2011, and this has motivated the conventional banks to engage in Islamic banking via opening Islamic Windows (Al-Saed, 2012). Thus, the results can be used as a guide to conventional banks who plan to open Islamic windows in the future.

1.7 Organization of the Study

In this chapter, the discussion on the background of the study, the research problem and the objectives of this study are provided. Also, provided in this chapter are the motivations of this study and its significance. The outline of the remainder of this thesis is as follows. In Chapter 2, a review of literature relevant to the study and related theories is provided. The methodology of the study as well as hypotheses development is presented in chapter 3. In chapter 4, the empirical results of the study are presented and discussed. In chapter 5, conclusion about the overall results is drawn, acknowledgements of the study's limitation are made and the implications of the study are identified. Also discussed in this chapter are the potential issues for research in the future.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

The main objective of this chapter is to review the conceptual framework for the bank efficiency study and to review the techniques that have been utilized in estimating the bank's efficiency. Extensive researches were conducted by previous researchers as contained in most literature on bank efficiency. The literature is drawn and reviewed based on the studies regarding major determinants of bank efficiency. In this context, reviews of the efficiency definition and classification are indicated in Section 2.2 and Section 2.3 that explain the methods of measuring efficiency. Section 2.4 reviews the two main approaches used in defining specification of inputs and outputs. Thereafter, Section 2.5 reviews the previous literature on bank efficiency and underlying theories of efficiency are discussed in Section 2.6. Then, Section 2.7 reviews the previous literature on the determinants of bank efficiency. Lastly, this chapter ends with a conclusion in Section 2.8.

2.2 Efficiency Definition and Classification

The product or service unit efficiency analysis can be calculated by comparing between the outputs and inputs utilized in the process of the product's or the service's production. The following Figure (Figure 2.1) illustrates the process.

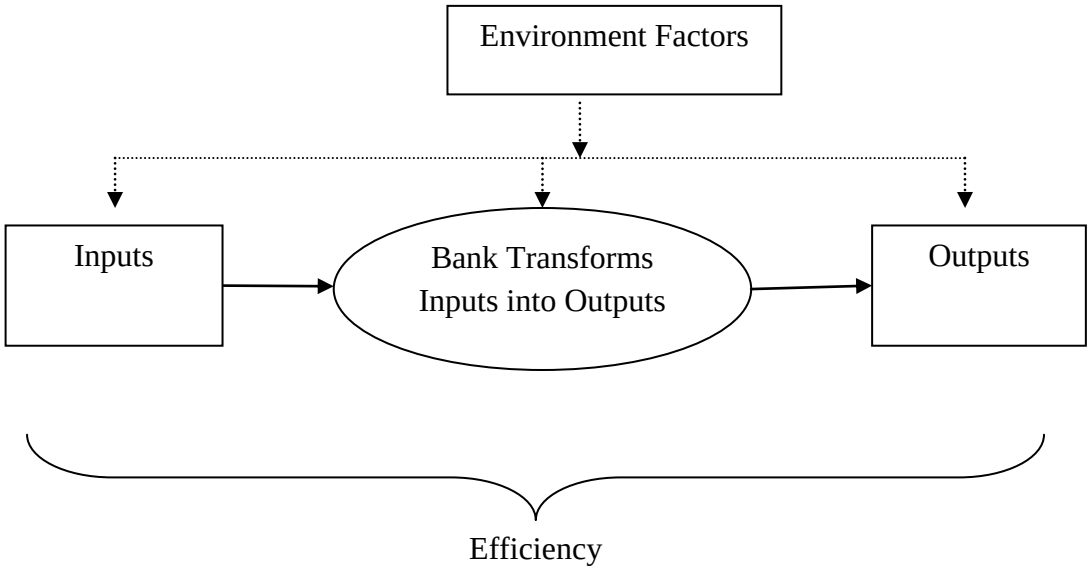

Figure 2.1:
The Efficiency Analysis Framework
Source: Chu and Lim (1998); Mokhtar *et al*., (2006)

Measurement of efficiency is one element that determines a firm's performance. It can be measured by determining the maximization of output, minimization of cost or maximization of profits. Efficiency can be divided into several categories, i.e., economic efficiency, allocative efficiency and technical efficiency.

2.2.1 Economic Efficiency

The concept of economic efficiency is very broad compared to technical efficiency. It has to do with the optimal choice of input and output levels and their mixture on the basis of responses to market prices (Bauer, Berger, Ferrier & Humphrey, 1998). This is a tool that must be considered in an organization in order to retain or sustain existence and production. Thus, when price data is available, economic efficiency can be calculated. A

firm is said to be efficient economically if its choices of combination of input and output levels are optimal to realize its economic goal (this involves minimization and maximization of cost and profit respectively). This is done through the combination of technical efficiency and economic efficiency, popularly called value engineering analysis. Economic efficiency requires both technical and allocative efficiency in order to evolve a production system that will give way to effective production, with reduction in cost, increase in profit margin and retention of product quantity and quality.

2.2.2 Allocative Efficiency

Allocative efficiency arises owing to the proportional minimization of costs after the firm has reached its optimal combination of inputs (Hassan, 2005). In other words, this type of efficiency concerns the factors or production cost which is uncontrollable as it is mostly due to regulatory policies of the government and various market factors. Therefore, allocative efficiency is not determined through the calculation of the available or unavailable input or output cost, but through the uncertainties of market price changes as well as changes in government policies.

2.2.3 Technical Efficiency

Technical efficiency focuses on the physical relationship between levels of input relative to level of output, so only the data relating to input and output are needed without the prices (Bauer *et al*., 1998). A firm is said to be efficient technically if its inputs are either minimized at a specified level of its outputs or its outputs are maximized at a specified level of its inputs. Generally, the reason why technical efficiency is measured is to determine whether in its process of production, a firm employs the best technology

available. Technical efficiency can be decomposed into pure technical efficiency and scale efficiency (Banker, Charnes & Cooper, 1984).

2.2.3.1 Pure Technical Efficiency

Pure technical efficiency is defined as *"the excess usage of input level at a given output level due to management of the operations of the firms"* (Chan, 2008).Therefore, it is the measure of the ability of a bank to avoid waste by producing as much output as input usage will allow, or using a little input as output level will allow.

2.2.3.2 Scale Efficiency

The firm's productivity is measured by scale efficiency at a particular point depending upon what it could achieve if it operated at the optimum scale size, with the maximum level of average productivity (Kounetas & Tsekouras, 2007), which means that scale efficiency is considered as the firm's ability to work at its optimum scale.

Conceptually, these components can be illustrated by the diagram below which is developed by Farrell (1957). To illustrate his ideas, a simple example is used by Farrell which involves firms that, under the assumption of constant returns to scale (CRS), produce a single output q, by employing x_1 and x_2 inputs. In Figure 2.2, the curve SS' represents the unit isoquant of the efficient firm which permits the measurements of technical efficiency.

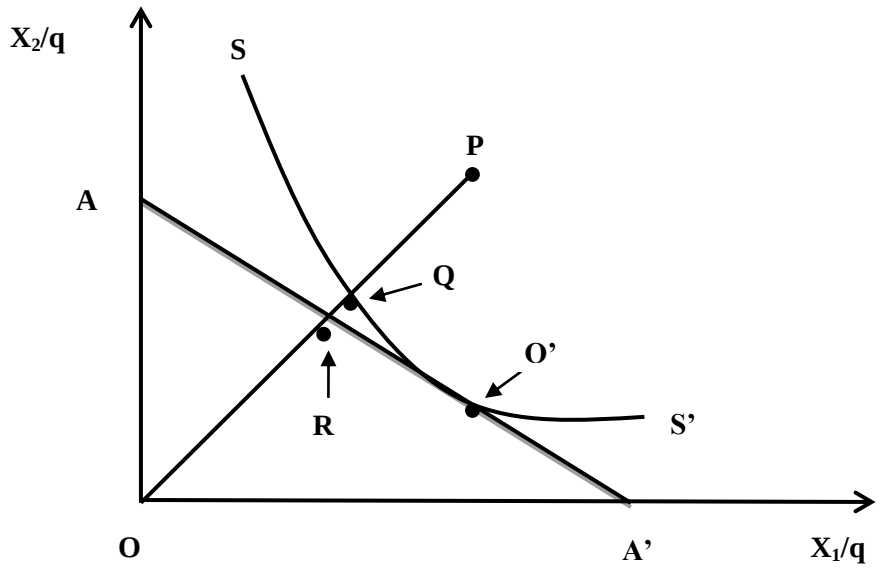

Figure 2.2
*Technical and A*llocative *Efficiency*
Source: Coelli *et al*., (1998)

In this Figure, a point such as P represents the input of the two factors that a firm employs for the production of one (1) unit of output. The distance QP represents the firm's technical inefficiency and the quantity by which all inputs can be decreased proportionately without decreasing output. Usually, it is expressed in terms of percentage, in the ratio QP/ OP. The expression stands for the proportion by which all inputs can be decreased. Thus, the firm's technical efficiency (TE) is usually measured as follows:

Technical efficiency = OQ /OP

This also equals to 1- QP/OP implying that its values range from zero and one. Thus, the values indicate the level of the firm's technical inefficiency. For a full technical

efficiency of a firm, the value is one. For instance, technically efficient point is point such as Q lying on the efficient isoquant SS'.

If input prices are known and represented by the price line AA', then allocative efficiency (AE) can be calculated as:

Allocative efficiency = OR/OQ

If production took place at Q' instead of point Q, then cost could be reduced by the distance RQ. The overall efficiency or economic efficiency (EE) is defined as:

Economic efficiency = OR/OP

EE = OR/OP = TE ×AE = (OQ/ OP) × (OR/OQ)

2.3 Methods of Measuring Efficiency

Efficiency can be measured by using two main approaches. First, is the parametric approach (or econometric approach) and second, is the non-parametric approach (mathematical programming). Different techniques are used by these two approaches to envelop a data set and their assumptions for random noise as well as for the structure of production technology differ.

2.3.1 Parametric Approach

There are three types of parametric or econometric techniques that are normally used in efficiency studies. They are stochastic frontier approach, the thick frontier approach and finally, the distribution free approach.

2.3.1.1 Stochastic Frontier Approach (SFA)

The stochastic frontier approach or SFA stresses on the functional association between cost and profit, as well as production relations among inputs, outputs and environmental factors, and provides room for error. The SFA recommends a composed error model wherein it is assumed that inefficiencies are distributed asymmetrically, while random errors are distributed symmetrically. The former is generally the half-normal error while the latter is the standard normal error. The rationale behind the model is that it is important that inefficiency follows a truncated distribution as it cannot have a negative sign. In the model, both errors and inefficiencies are orthogonal to variables such as input, output or environmental variable that are included in the estimated model. The approximate inefficiencies of a firm are considered as the conditional average or distribution method relating to the inefficiency term, based on the observed calculated error term.

The half-normal of the inefficiencies distribution is comparatively inflexible and assumes that majority of the firms are grouped close to full efficiency. Practically, other distributions may be more suitable (Greene, 1990). However, research dedicated to financial institutions reveals the stressing on the truncated normal distribution of inefficiency results in minor but statistically significant varying results from the half-normal distribution case (Berger & DeYoung, 1997). The same result surfaced when utilizing data relating to life insurance using gamma flexible distribution (Yuengert, 1993). Nevertheless, the method of enabling the flexibility of the assumed distribution of inefficiency may result in the difficulty in separating inefficiency from random error in a framework that is characterized as composed-error, because the truncated normal and

gamma distributions may be in close proximity with the assumed symmetric normal distribution of the random error.

2.3.1.2 Distribution-Free Approach (DFA)

This approach is characterized as a functional form for the frontier although it separates the inefficiencies from the random error in a distinct method. Contrary to SFA, DFA does not make strong assumption about particular distributions of both inefficiencies and random errors, but it presumes the firm's efficiency is unchanging while random error mostly ends up averaging into zero over time (Berger, 1993). The approximate inefficiency of individual firms in a set of panel data is determined as the difference between its average residual and the average residual of the firm on the frontier. Hence, with DFA, inefficiencies are allowed any type of distribution, even an almost symmetric one, as long as they have non-negative inefficiencies. But if efficiency moves over time owing to technical changes, regulatory reform, interest rate cycle or due to the effect of other factors, then DFA considers the average deviation of individual firms separate from the best efficiency at one particular time (Berger & Humphrey, 1997).

2.3.1.3 Thick Frontier Approach (TFA)

TFA represents a functional form and considers the deviation of predicted performance values as within the greatest and least performance quartiles of observation, representing random error and deviations within the same quartiles representing inefficiencies (Berger & Humphrey, 1997). The TFA lays down no assumptions regarding distribution of inefficiency or random error, except for the assumption that inefficiencies are different between the extreme quartiles but within the quartiles the random error is

present. In addition, the TFA fails to give point of estimates for efficiency concerning each firm. Instead, TFA provides general overall efficiency level. This method minimizes the impact of extreme points recorded in the data, just as DFA does during the truncation of extreme residual mean.

2.3.2 Non-Parametric Approach

The method of non-parametric that is normally used in efficiency study of the banking sector is the Data Envelopment Analysis (DEA). In this technique, specification of a priori functional form is not required and this makes the approach the most favorable one.

2.3.2.1 Data Envelopment Analysis (DEA)

This type of analysis is utilized to measure the relative performance of banks and it is widely accepted method for determining the inefficiency decision making units (DMUs) in the industry. The analysis was first proposed by Charnes, Cooper and Rhodes (1978).

DEA is a linear programming technique in which the set of frontier observations are DMUs for which no other DMU produces as much or more of every output (given input) or uses as little or less of every input (given output). In other words, DEA is commonly used to evaluate the efficiency of a number of producers or DMUs. The production process for each producer is to take a set of inputs and produce a set of outputs. Each production has a varying level of inputs and gives a varying level of outputs. The ratio of outputs to inputs is a commonly used measure of efficiency (Berger & Humphrey, 1997).

DEA's first pioneering application in the banking sector was carried out by Sherman and Gold (1985), when they attempted to evaluate the operating efficiency of banks. In the following century, Berger and Humphrey (1997) carried out a review of 122 frontier studies of financial institutions and found that 69 studies made use of non-parametric methods for estimation and 62 studies made use of DEA for analysis.

The DEA method, as a non-parametric technique, permits analysis of small sizes; it is especially useful when the sample size is limited, as it is for Yemen's banks. Other parametric methods, such as SFA, DFA and TFA, require large sample sizes in order to obtain better or more degrees of freedom for valid results. Compared to commonly used performance measurements, such as ratio and regression analysis, DEA focuses on the outliers. Specifically, DEA identifies units that achieve the best results. Therefore, DEA allows for the examination of best performance and their best practices and gives the efficiency score for each bank. It gives information on how each different bank performs. Hence, the DEA solution is unique for each DMU under investigation, which allows a direct comparison to be made against a peer or a combination of peers.

2.4 Specification of Inputs and Outputs

In order to analyze the efficiency score of banks, the determination of inputs and outputs of the banking sector is needed. Nevertheless, while there is an increasing attempt to study the efficiency of the banking industry, researchers have not reached a consensus as to what are the best inputs and outputs. The pioneering studies that attempted to define the concepts were Sealey and Lindley (1977), Colwell and Davis (1992) and Berger and Humphrey (1997). Two main approaches are notable for providing the definition of both

inputs and outputs of the banking sector. They are the production and the intermediation approach and both make use of the traditional microeconomic theory of the firm to banking and with each providing distinct characteristics to banking activities.

2.4.1 Production Approach

Benston (1965) was the first to propose the production approach which defines financial institution as a producer of service for account holders. In other words, they carried out transactions on deposit accounts and process loans. Based on the approach, the best way of measuring output is by the number of transactions, by the transaction type or by documents processed over a particular given period of time. Unluckily, such explicit transaction flow data is distinctively apt, but generally unavailable. Therefore, data sometimes employed instead are those on the stock number of deposit or loan accounts serviced data. The inputs are defined to be the physical inputs, like labor and capital, for which their costs ought to be added because the only requirement for the performance of transactions and processing of financial documents are the physical inputs. The approach is invaluable in studying bank branches' efficiency as these branches carry out documental processes for the banks (Berger & Humphrey, 1992).

2.4.2 Intermediation Approach

The intermediation approach defines financial institutions as the main intermediating funds between savers and investors. This approach was suggested by Sealey and Lindley (1977) and assumes that banks use operating and interest expenses to produce major assets. In this approach, they used labor, deposit and capital as inputs to produce loans, investments and other means of financing as outputs.

Al-Jarrah and Molyneux (2003) provide a summary listing the advantages of intermediation approach over other approaches. The intermediation method considers deposits as inputs which are more suitable as banks make use of deposits and other funds for their loans and investments. This is further supported by Elyasiani and Mehdian (1990) who advocate that banks buy instead of sell deposits. Moreover, the units of bank inputs and outputs under this method are measured according to monetary values that present the market share of banks individually. Also, some services cannot be measured according to the number of accounts, like investments in securities. Moreover, this approach is very important to financial institutions since it includes interest expenses which explain one-half to two-thirds of the entire costs (Sathye, 2001; Rao, 2002).

2.5 Bank Efficiency

Berger and Humphrey (1997) presented an extensive international literature survey on the efficiency of financial institutions by examining 130 studies performed using different efficiency techniques, including DEA, in 21 countries. They found that the efficiency estimates from non-parametric studies (DEA) were mostly similar to those from parametric frontier models (the SFA, the DFA, and the TFA). The authors found that the deregulation of financial institutions could either increase or decrease the efficiency levels, depending on the industry conditions before the deregulation.

In the context of Gulf Cooperation Council (GCC), Limam (2001) and Alsarhan (2009) investigated the technical efficiency in the banking industry. Limam's (2001) study concentrated on only year 1999 and used dual methods. The first method comprised a non-parametric linear frontier with linear programming (DEA); while the second method

comprised the estimation of the parametric frontier through the correction of ordinary least square (COLS). Limam's (2001) study used an intermediation approach to define both outputs (the entire types of loans and investments as well as deposits) and inputs (fixed assets, bank employees and financial capital incorporating deposits, borrowings as well as liabilities not covered by deposits or borrowings). In conclusion, Limam reported Bahrain and Saudi Arabia banks were more efficient technically as compared to their counterpart countries in the GCC.

In the same vein, Alsarhan (2009) estimated the technical efficiency in banking industry of the Gulf region from 2000-2007, using the DEA technique. Intermediation approach was employed to choose the input (deposits, capital, and general administration expenses) and output (investment, total operating income). The results showed an improvement in the average efficiency scores for the GCC banking sector, and it also revealed that the banking sector in Qatar, Bahrain and the United Arab Emirates were more efficient than their counterparts in Kuwait, Saudi Arabia, and Oman. Comparing with Limam's (2001) study results, the findings of Alsarhan's (2009) study provide indication of the efficiency development of the GCC banking sector over time.

In the context of Turkey, Isik and Hassan (2002) examined input and output efficiency using non-parametric and parametric techniques. The profit, cost, allocative, technical, pure technical and scale efficiency are estimated for Turkish banks over the 1988-2006 period. They revealed that the heterogeneous features of banks significantly affect efficiency and that various banking features affect the differences in bank efficiency. Moreover, cost and profit efficiencies showed a steady decline in the efficiency over

time, attributed to technical inefficiency compared to allocative inefficiency, that in turn (i.e., technical inefficiency) results from diseconomies of scale.

A non-parametric DEA method was also employed by Casu and Molyneux (2003) to examine whether the European banking system efficiency score has influence over other banks. Tobit regression model was employed to analyze the influence of distinctive countries' particular factors as well as environmental factors relating to bank efficiency to assess the factors that determine European banking efficiency. An intermediation method was used for the specification of two outputs, namely other earning assets and total loans, and two inputs, namely total costs and total deposits. They found that across the European banking systems, efficiency levels differed, and this variation was as a result of particular factors of each country associated with banking technology.

In India and Pakistan, Ataullah *et al*. (2004) carried out an investigation of technical efficiency, as well as the effect of financial liberalization on the banking system by using DEA and data from the commercial banks from the period 1988-1998. They revealed that the banking industry's overall efficiency was enhanced by financial liberalization and the enhancement manifested itself from 1995-1996. In addition, Indian banking efficiency significantly improved owing to pure technical efficiency as well as scale efficiency. However, in Pakistan, increased overall efficiency resulted from increased scale efficiency.

Havrylchyk (2006) approximated the cost efficiency, allocative efficiency, technical efficiency, pure technical efficiency and scale efficiency of the Poland banking industry

over the period 1997 to 2001 through the use of DEA. The items chosen as outputs were government bonds, loans and off-balance sheet items; while those chosen for use as inputs under intermediation approach included labor, capital and deposits. His findings revealed that the mean efficiency of domestic and foreign banks was 52.92 percent and 73.23 percent respectively. In addition, foreign banks demonstrated having higher inputs productivity (indicating technical efficiency) and proved to be effective in choosing the appropriate inputs mix with respect to the prices given (indicating an allocative efficiency). He also noted that the efficiency of the Polish banking system remained the same during the study period.

Moffat (2008) examined the technical efficiency of the banking sector in Botswana through the DEA method. He utilized three approaches that are intermediation approach, value added approach and operating approach to select the input and output. Under intermediation approach, Moffat (2008) defined deposits, labor and capital related operating expenses as inputs and loans and investment as outputs. The findings revealed that based on the three approaches the overall mean score for efficiency of the financial institutions was 0.62. In addition, the inefficiency identified from the current scale operation is under intermediation approach. Moffat (2008) stressed there is a need for governmental support to some public owned-institutions to ensure the creation of a conducive environment for effective utilization of scarce resources.

In Malaysia, Sufian (2009) investigated the banking sector's efficiency during the financial crisis in Asia in 1997. The estimates of efficiency in individual banks were evaluated through the DEA method, utilizing intermediation approach, value added

approach and operating approach in an attempt to highlight how efficiency scores differ with the changes in inputs and outputs. The findings revealed that although technical efficiency appears to dissipate a year following the Asian Crisis, the dissipation is more pronounced in the intermediation approach mode.

Ahamed *et al*. (2010) investigate the Islamic banking sector efficiency on a global scale involving 25 countries from the period 2003-2009 through the non-parametric DEA method. Their results indicated that during the mentioned period, pure technical efficiency was higher than scale efficiency in the Islamic banking sector of the world which implies that the Islamic banks have been efficient in managing their resources in the best way possible. They also revealed that pure technical efficiency has a higher influence in the determination of the total technical inefficiency of the Islamic banking sector of the world. They suggested that the countries with high income Islamic banks appear to be leading and dominating the most efficient frontier during the study period.

In Saudi Arabia, a study on the technical efficiency on nine banks was done by Assaf, Barros and Matousek (2011) using DEA with the method of intermediation over the period 1999 to 2007. The input comprised off-balance sheet activities and total customer loans; while the output comprised total employees, fixed assets and total deposits. The findings implied that the average efficiency score of banks in Saudi Arabia had gradually increased from 85.89 percent in 1999 to reach an average efficiency level of 90.21 percent by 2007. In the same year, majority of the banks were operating at a high efficiency and these included Fransi Bank, SAAB, Jazira and Hollandi Bank. The least

efficient banks were Riyad Bank and Samba, with an average technical efficiency of 86.71 percent and 88.84 percent respectively.

In Jordan, Jreisat and Paul (2011) examined efficiency levels of banking sector for 13 domestic and three foreign banks from 1996 to 2007, by estimating a non-parametric approach namely DEA. The input comprised labor and total deposits; while the outputs comprised total loans and other investments. Findings indicated that the efficiency of large banks was greater than that of small banks and domestic banks seemed to be efficient more than the foreign banks. In addition, the Arab Bank was found to be the most technically efficient among the large banks, while the Capital Bank of Jordan was more technically efficient on average among all the medium banks in the sample. Table 2.1 below summarizes the previous studies related to the banks' efficiency.

Table 2.1
Summary of Prior Studies on Efficiency of Bank and the Inputs and Outputs used in DEA.

Author (Years of study)	**Country**	**Period examined**	**Inputs and outputs used in the intermediation approach**
Limam (2001)	GCC	1999	Inputs: fixed assets, labor and financial capital. Outputs: earning assets, loans and investments.
Isik and Hassan (2002)	Turkey	1988-2006	Inputs: capital, labor and loanable funds. Outputs: long-term loans, short-term loans, risk-adjusted off-balance sheet items and other earning assets.
Casu and Molyneux (2003	Europe	1993-1997	Inputs: total costs and total customers and short-term funding. Outputs: total loans and other earning assets.
Ataullah *et al*. (2004)	India and Pakistan.	1988-1998	Model A: (loan-based model) postulates that banks incur operating and interest expenses to produce loans and advances, and investments. Model: B (income-based model) postulates that banks incur operating and interest expenses to produce interest and non-interest income.
Havrylchyk (2006)	Poland	1997-2001	Inputs: labor, capital and deposits. Outputs: government bonds, loans, and off-balance sheet items.
Moffat (2008)	Botswana	2001-2006	Inputs: labor, deposits and capital related operating expenses. Outputs: Loans and investment.

Table 2.1 (Continued)

Author (Years of study)	**Country**	**Period examined**	**Inputs and outputs used in the intermediation approach**
Sufian (2009)	Malaysia	1995-1999	Inputs: labor, deposits and capital. Outputs: investments and loans.
Alsarhan (2009)	GCC	2000-2007	Inputs: deposits, capital, and general administration expenses. Outputs: investment and total operating income.
Noor *et al*. (2010)	Islamic countries[1]	2003-2009	Inputs: labor, deposits and physical capital. Outputs: investments and loans.
Assaf, Barros and Matousek (2011)	Saudi Arabia	1999 - 2007	Input: total customer loans and off-balance sheet activities. Output: total employees, total deposits and fixed assets.
Jreisat and Satya Paul (2011)	Jordan	1996 – 2007	Input: labor and total deposits. Outputs: total loans and other investments.

[1]Bangladesh, Bahrain, Brunei, Egypt, Gambia, Iran, Indonesia, Jordan, Kuwait, Mauritania, Malaysia, Palestine, Pakistan, Syria, Singapore, Saudi Arabia, South Africa, Sudan, Turkey, Thailand, UAE, United Kingdom, Qatar and Yemen.

In this study, the technical, pure technical and scale efficiencies are examined using the DEA approach, which was originally developed to measure overall technical efficiency in the public and not-for-profit sectors (Favero & Papi, 1995). The DEA model has been extended to cover profit making sectors, such as commercial banks, in order to analyze economic efficiency. Under public ownership, profit maximization or cost minimization (thus fulfilling the condition of economic efficiency) may not be the main objective of an enterprise. On the other hand, profit maximization is the ultimate objective of private enterprises, such as banks. As mentioned before, financial institutions in Yemen fall into two distinct classes, i.e., private ownership and state (or public) ownership, and hence, the managers of these two distinct classes may follow different agendas and economic goals. Therefore, it seems reasonable to assess overall technical efficiency rather than economic efficiency by applying the DEA approach.

2.6 Underlying Theories of Efficiency

The aim of this section is to introduce the underlying theoretical foundations for this study which form the basis for the rest of the thesis.

2.6.1 Divisibility and Shakeout Theory

Maghyereh (2004) have identified two theories regarding the relationship between bank size and performance. The divisibility theory posits that large banks will have no operational advantage compared to small-scale banks as they are able to produce financial services at costs per unit output comparable to those of large banks, if the technology is divisible. Hence, the divisibility theory stresses no (or a negative) association between size and efficiency. However, the shakeout theory posits that

smaller banks are unable to collect sufficient capital compared to large banks because they lack management ability. These imply a positive link between size and performance.

2.6.2 Moral Hazard Theory

According to the moral hazard theory, when there is lower capital ratio, moral hazard behavior could be caused such that the managers of the banks could resort to taking risky projects as a means of boosting their earnings in a short period of time, and later resort to taking more risky behavior in a long term period with the potential consequence of harming the efficient operation of the banks (Fiordelisi, Marques-Ibanez, & Molyneux, 2010; Lozano-Vivas *et al*., 2002). The theory maintains that with less capital to lose by owners, there might be less incentive on their part to ensure that the bank operates efficiently. As a result, bank managers having lower equity and whose monitoring by owners is less, might have greater incentive to take advantage of the benefits.

2.6.3 Bad Management Theory

Various studies dedicated to efficiency studies reveal that firms with greater problem loans are more inclined to be less effective compared to those with lesser problem loans (Isik & Hassan, 2003). The bad management hypothesis states that problem loans that result from controllable factors, like poor management decision, will lead to cost efficiency.

'Bad' managers could (i) possess inadequate skills in credit scoring and for this reason, opt for a relatively high percentage of loans that its net present value is negative or low; (ii) not be fully competent enough in evaluating the collateral value guaranteed in respect of the loans; and (iii) have problem or complexity in monitoring and controlling the borrowers after loans are issued. Therefore, the hypothesis predicts that non-performing loans and efficiency will have negative relationship.

2.6.4 Eclectic Theory

The eclectic theory of international production was discussed by Dunning (1977). The advantage of internationalization which results from scale efficiency is the main issue implied in this theory. Hence, banks which have an international presence may improve efficiency as this leads to economic of scale.

Dunning's (1977) eclectic theory of international production was extended by Gray and Gray (1981) in their attempt to study multinational banking. The eclectic theory posits that multinationalization of banks is dependent on ownership, location and internationalization (Rugman, 1981). Cho (1985) reinforced the theory by carrying out an evaluation on the USA bank branches in Korea and Singapore. Therefore, with this theory, it can be justified that inter-relationships exist between the proposed variable (internationalization of operation) and the efficiency of the banks under study.

2.6.5 Resource-Based Theory

Under the resource-based theory, a firm is viewed as a bundle of resources (tangible and intangible resources), suggesting that these resources are a source of sustainable

competitive advantage if they are valuable, rare, inimitable, and non-substitutable (Barney, 1991; Grant, 1991). The resource-based theory views intellectual capital as well as physical and financial capitals as strategic resources, considering that firms gain competitive advantage and superior performance through the acquisition, holding and efficient use of these strategic resources (Zeghal & Maaloul, 2010).

The effect of information technology (IT) investments on firm performance can be explained by the resource-based view. Various researchers, including Santhanam and Hartono (2003), reveal that a firm's ability to take advantage of its IT investments through the development of IT infrastructure may lead to significant improvements. As a result, corporations generally have appropriate resources in order to obtain IT-related products as they assume that these types of investments lead to economic returns. Moreover, Bharadwaj (2000) states that if firms are able to combine IT related resources to form a one of a kind IT capability, this may lead to significant performance. Bharadwaj (2000) further adds and shows that the firm's average performance with superior IT capability is greater than the average performance of its counterparts.

More recently, the intellectual capital-based theory developed by Reed, Lubatkin and Srinivasan (2006) has been advanced as one specific aspect of resource-based theory. Reed *et al*. (2006) argue that intellectual capital is the only source of competitive advantage and value added to the firm because it is difficult to imitate and substitute, and it has imperfect mobility, whereas physical capital is a generic resource, easily imitable and substitutable, and can be easily purchased and sold in the open market.

Hence, it is only the intellectual capital that deserves to be considered as strategic resource to allow a firm to create value added.

2.7 Determinants of Efficiency

The identification of the factors that explain differences in efficiency is essential for improving the efficiency of banks although, unfortunately, there is no theory suggesting the exact determinants of efficiency (Aggrey, Eliab & Joseph, 2010). For financial institutions, few analyses on efficiency have been informative in identifying exogenous determinants of efficiency (Berger & Humphrey, 1997). In addition to this, the limited knowledge of basic determinants of banking efficiency in developing countries worsens the situation (Olson & Zoubi, 2011). Thus, the variables are chosen based on their previous empirical success.

2.7.1 Size

Banking literature advocates that bank size may be significantly linked to its efficiency. It is hypothesized that large banks may have professional and effective management teams or they may be comparatively cost conscious than management teams in small banks as their owners stress on bottom-line profits (Evanoff & Israilevich, 1991).

The existing literature demonstrates differences in the relationship between size and efficiency. A related study by Berger, Hunter and Timme (1993) revealed that the positive relation between efficiency and size may not be visible as factors signifying so are not yet conclusive. Larger firms may be generally efficient owing to their ability to produce maximum output. In other words, larger banks may have greater profits for a

particular price because they have gradually increased in size over a certain period. On the other hand, small banks are not able to achieve this caliber of success in the short run. There is also the possibility that firms with greater efficiency are more competitive, and as a result, they gradually become large. Literature reveals arguments that bank size should be linked to efficiency (Reda & Isik, 2006).

Most studies that used asset size find inconsistent results for the relationship between size and efficiency. Ajlouni, Hmedat and Hmedat (2011) Reda and Isik (2006), Ataullah and Le (2006) and Maghyereh (2004) find that larger banks are more efficient, i.e., as banks tend to increase their asset size, they become more efficient. In addition, Chen, Skully and Brown (2005) find that both large and small banks showed better efficiency compared to their medium-sized counterparts. This is contradictory to the USA situation, whereby the average cost curve showed a flat U-shape implying the medium-sized banks' efficiency. Table 2.2 below summarizes the studies that examined size with efficiency.

Table 2.2
Summary of Size and its Impact on Efficiency

Author (s)	**Country**	**Period**	**Findings**
Almumani (2013)	Saudi Arabia	2007-2011	The study found smaller banks are the most efficient.
Ajlouni *et al*. (2011)	Jordan	2005-2088	Find that the efficiency of larger banks is higher than that of smaller and medium size banks.
Ataullah and Le (2006)	Indian	1992-1998	Report that size has a positive relationship with efficiency.
Havrylchyk (2006)	Poland	1997-2001	No relationship between size and efficiency.
Reda and Isik (2006)	Egypt	1995-2003	The relationship between size and efficiency is positively correlated.
Chen *et al*. (2005)	China	1993-2000	The study found larger banks and smaller banks are the most efficient.
Maghyereh (2004)	Jordan	1985-2001	Significant positive effects on efficiency supported the shakeout theory.
Isik and Hassan (2002)	Turkey	1988-1996	The relationship between size and efficiency is negatively correlated.

Table 2.2 (Continued)

Author (s)	**Country**	**Period**	**Findings**
Avkiran (1999)	Australian	1986-1995	The relationship is not significant.
DeYoung and Nolle (1996)	USA	1985-1990	The smaller banks are more profit efficient than large banks.
Kaparakis *et al*. (1994)	USA	1986	Banks becoming less efficient with increase in size.
Hermalin and Wallace (1994)	USA	1986-1989	Significant negative relationship with efficiency.

On the other hand, Almumani (2013) shows that smaller banks significantly outperforms medium- and larger-size banks in term of relative efficiency. Isik and Hassan (2002) study indicate that size is negatively related to efficiency. Although there are higher costs recorded for the small and medium-size banks, their technical and scale efficiency are better compared to their larger counterparts. Additionally, smaller banks are profit efficient than larger ones and these findings support previous studies, including DeYoung and Nolle (1996), Hermalin and Wallace (1994) and Kaparakis, Miller and Noulas (1994). These studies revealed that efficiency measurement shows no scale biases leaning to large banks. In addition, Havrylchyk (2006) and Avkiran (1999) find bank size does not significantly affect efficiency.

2.7.2 Profitability

Profitability is considered as a set of financial metrics utilized in the assessment of the business's ability to produce earnings as opposed to expenses and other relevant costs in a particular duration of time. When a company has a higher value of ratio compared to its competitors or compared to the same ratio of a past duration of time, it is considered to be performing well.

Return on equity (ROE) and return on assets (ROA) are used to measure profitability. Mester (1993) reports that return to average equity is positively connected to ROA with efficiency since more efficient banks are likely to indicate higher profit earnings. A low ROA of banks may either be due to conservative lending and investment policies or excessive operating expenses. In contrast, a high ROA may be a result of efficient operations, a low ratio of time and savings deposits to total deposits, or of high yields

earned on the assets. Moussawi and Obeid (2011) state that a bank that tends to enhance its profitability selects the efficient factors of production in order to reduce its costs, as well as enhance its efficient production. Moussawi's and Obeid's (2011) findings are consistent with previous studies, such as Alsarhan (2009), Sufian (2009), Pasiouras (2008) and Yildirim (2002), who find that profitability significantly influences efficiency.

On the other hand, it has been argued that profitability may affect efficiency negatively. According to Moussawi and Obeid (2011), banks having reserve profit or market power could likely have lesser incentives as compared to others to improve production efficiency. It was further stated that in a case where the degree of competition is very high, well-established banks with respect to efficiency, can select or be forced to select a marketing policy which can prevent them from realizing a high profitability level. In India, Ataullah and Le (2006) find that high profitability, which is measured by ROA is negatively related to bank efficiency due to NPLs for the period 1992-1998. Similarly, Casu and Girardone (2004) find that profitability of the commercial banks in Italy affect efficiency negatively for the period 1996-1999. Table 2.3 below summarizes the studies that examined the relationship between profitability and efficiency.

Table 2.3
Summary of Profitability and its Impact on Efficiency

Author (s)	**Country**	**Period**	**Findings**
Moussawi and Obeid (2011)	GCC	2005-2008	ROA contribute significantly to efficiency.
Alsarhan (2009)	GCC	2000-2007	ROE is positively related efficiency.
Sufian (2009)	Malaysia	1995-1999	Indicated that lower inefficiency is associated with more profitable banks.
Pasiouras (2008)	Greece	2000-2004	ROA is positively associated with efficiency.
Ataullah and Le (2006)	Indian	1992-1998	ROA negatively and significantly influenced efficiency depending on the specification of the model.
Casu and Girardone (2004)	Italy	1996-1999	Reported a negative and statistically significant relationship.
Yildirim (2002)	Turkey	1988-1999	Efficient banks are more profitable.
Mester (1993)	USA	1991-1992	Profitability and efficiency are positively associated.

The relationship between profitability and bank efficiency has been investigated by several studies in both developed (Casu & Girardone, 2004 in Italy) and developing countries in Europe (Pasiouras, 2008 in Greece; Yildirim, 2002 in Turkey) and Asia (Sufian, 2009 in Malaysia; Ataullah & Le, 2006 in India). In the context of the Middle East, this issue was investigated by Alsarhan (2009) in GCC countries. However, in spite of the studies on the relationship between profitability and bank efficiency in some developed and developing countries, no such study has been documented in the context of Yemen.

2.7.3 Financial Capital

The impact of capital adequacy on bank's efficiency has become important due to the focus of substantial debate on capital requirements at the onset of the global financial crisis. The average capital ratio is calculated using equity over total assets. It shows the level to which shareholders have their capital at risk in the financial institution, and hence, they may show their concern over the monitoring of management. Average capital ratio provides an indicator about the efficient operation of the institution and the management's compliance with capital requirements and regulations. A result with lower ratio is considered to facilitate a lower level of efficiency and the ratio of lower equity to total assets is related to the probability of taking higher risk and greater leverage, and therefore, the costs of borrowing is higher.

This rationale is also buttressed by Park and Weber (2006) who stress on the fact that with the increase in capital ratio, the bank customers' confidence will also increase

owing to the decrease in portfolio risk alongside the anticipated financial problems cost. The theoretical positive relationship between financial capital ratio and efficiency is supported by several studies, such as Pasiouras (2008) Rao (2005) Casu and Girardone (2004) Isik and Hassan (2003) and Berger (1995), who indicate that banks having higher equity with respect to their ratio of total assets are anticipated to perform better. However, Chan (2008) argues that the positive effect of high financial capital ratio on efficiency is a contingent to the environment in which a bank is operating. Chan (2008) concludes that in any environment where the financial capital offers a relatively cheaper source of funding in comparison to some deposits as well as other liabilities, and without subjecting the equity portion to explicit reserve requirement or interest cost, the positive effect of high financial capital ratio on efficiency appears clearly.

On the other hand, bank efficiency and equity to total assets ratio could be related negatively. A higher value of the proportion of equity to total assets ratio shows that regulations on the capital requirement of banks are very stiff. Koehn and Santomero (1980) indicate the effect of capital requirement on the performance of banks to be uncertain and hinges on the aversion of risk distribution among banks. In such cases, banks which are typified to be non-risk averse have the greater tendency of opting for a combination of more risky assets as a result of a higher requirement, which could result in maximization of the possibility of bankruptcy. This is due to the fact that capital requirement provides the banks with incentive to liquidate fast, thus reducing their ability to honor deposits contracts (Diamond & Rajan, 2000). These arguments are supported by Almumani (2013), Ajlouni and Hmedat (2011), Sufian (2009), Chan (2008) and Maghyereh (2004). Nevertheless, Havrylchyk (2006) and Reda and Isik

(2006) find no relationship between capitalization and efficiency. These mixed and inconsistent findings have given rise to the need to test the variable again for further verification.

Moreover, based on Lozano-Vivas, Pastor and Pastor (2002), a lower capital ratio may result in moral hazard behavior, whereby banks may be encouraged to take risk projects for the sake of boosting earnings in the short run although it may be risky in the long run, and it may damage the banks' efficiency. In addition, Kwan and Eisenbeis (1995b) state that managers are more in control of their banks' investments and in order to consume more perquisites, they may operate in an inefficient manner through over-investments, when provided with more capital from banking institutions.

Furthermore, greater capital requirements lead to agency conflict among the shareholders of the bank, the bank managers and the creditors whose banks are performing and efficient. Besanko and Kanatas (1996) stress that when banks issue new equity to conform to the capital requirements, it may impact the shareholders' surplus which reduces the banks market value, particularly when shareholders fail to monitor the banks' performance efficiently.

Table 2.4
Summary of Financial Capital and its Impact on Efficiency

Author (s)	**Country**	**Period**	**Findings**
Almumani (2013)	Saudi Arabia	2007-2011	Banks whose capital adequacy ratio is higher are not very efficient.
Ajlouni and Hmedat (2011)	Jordan	2005-2008	Higher capital adequacy ratio leads to least efficiency.
Sufian (2009)	Malaysia	1995-1999	Exhibit negative relationship with bank efficiency.
Pasiouras (2008)	Greece	2000-2004	Well-capitalized lead to more efficiency of banks.
Chan (2008)	Developing countries	2000-2005	There is a negative relationship.
Reda and Isik (2006)	Egypt	1995-2003	Indicate that banks that are well capitalized are very efficient but are not significant.

Table 2.4 (Continued)

Author (s)	Country	Period	Findings
Havrylchyk (2006)	Poland	1997-2001	No relationship between capitalization and efficiency.
Rao (2005)	United Arab Emirates	1998-2001	The capitalization has a positive relation with efficiency estimates.
Casu and Girardone (2004)	Italy	1996-1999	Well-capitalized lead to more efficiency of banks.
Maghyereh (2004)	Jordan	1985-2001	Capital adequacy and all forms of efficiency are significant and negatively related.
Isik and Hassan (2003)	Turkey	1988-1996	The relationship between the capitalization and efficiency is positively related.

Financial capital has been studied in many countries of the world over the last few years as shown in Table 2.4. In the context of Malaysia and Turkey, Sufian (2009) and Isik and Hassan (2003a) respectively studied the financial capital and efficiency. In the European context, Pasiouras (2008) and Casu and Girardone (2004) also studied the effects of financial capital on banks. While particularly in the Middle Eastern context, Almumani (2013), Ajlouni and Hmedat (2011) Reda and Isik (2006) and Rao (2005) studied the effects of financial capital on banks and also suggested further investigation. But, to the best of the researcher's knowledge, no studies have been conducted in Yemen relating to this issue.

2.7.4 Non-Performing Loans (NPLs)

In this study, provisions of total loans are employed as substitute for the quality of loans a bank offers. Provisions are employed to explain or report non-performing loans. Problematic loans are non-performing loans for which required interest or principal payment has been due for payment over long time. Problematic loans result from some reasons which are controllable and/or uncontrollable (Berger & Mester, 1997). Controllable factors are ones which mirror overall quality of management, credit policy of the bank, insufficient analysis of credit, structuring of loan, and documentation of loan. Uncontrollable factors, in general, mirror unfavorable economic conditions, unfavorable regulatory change, changes in borrower's operations environment and disastrous events. As a result of exogenous factors, the expectation cannot be to get rid of loan losses absolutely. The realization of this can only be by declining to take credit risk, that decreases profitability. Thus, management of the bank, in general, expects to

account for some loan losses since loan officers are unable to forecast the future performance of the borrower perfectly.

Some studies on efficiency have investigated how the efficiency is related to asset quality. In these previous studies, measures of non-performing loans have directly been integrated to control for asset quality in cost functions or profit functions from which indices of efficiency are obtained. Other researches employed other approaches, and added non-performing loans as independent variables in the regression analysis (Reda & Isik, 2006; Mester, 1994).

Das and Ghosh (2006) show that without considering the input and output choice, a high level of non-performing loans has relationship with low efficiency estimates and for low level of non-performing loans the case is the opposite relationship. Therefore, the provisions for loan loss are added as explanatory variable of efficiency since they reflect the quality of assets or the risk the banks sustain (Chan, 2008). Several researchers have revealed that banks that are failing tend to be situated away from the best practice frontier (Wheelock & Wilson, 1995; Barr & Siems, 1994; Berger & Humphrey, 1992). Therefore, along with problem loans associated with high ratios, these banks still have a propensity to indicate low cost efficiency. As revealed by other studies, efficiency has negative relationship with problem loans even among banks that are still thriving (Karim, Chan & Hassan, 2010; Kwan & Eisenbeis, 1995a).

For example Moussawi and Obeid (2011), Sufian (2009), Moffat (2008), Reda and Isik (2006), Havrylchyk (2006) and Maghyereh (2004) find that loans loss provisions and

efficiency are negatively related. Their findings are consistent with the Berger and DeYoung's (1997) 'bad management hypothesis'. Increasing non-performing loans commonly deteriorates the financial institutions' efficiencies as a result of cost increment incurred to monitor, administer and sell-off these loans.

On other hand, Fan and Shaffer (2004) report that in the USA, non-performing loans have negative associations with the large commercial banks' profit efficiency, but statistically insignificant. Table 2.5 shows a summary of previous studies which found that non-performing loans are negatively related to efficiency.

Table 2.5
Summary of Non-Performing Loans (NPL) and its Impact on Efficiency

Author (s)	**Country**	**Period**	**Findings**
Moussawi and Obeid (2011)	GCC	2005-2008	NPLs have significant negative association with the efficiency.
Sufian (2009)	Malaysia	1995-1999	NPL indicates to have statistical significant negative association with bank's technical efficiency in the operation.
Moffat (2008)	Botswana	2001-2006	High level of NPL is associated with low efficiency.
Havrylchyk (2006)	Poland	1997-2001	The higher efficiency is negatively associated with NPL.
Reda and Isik (2006)	Egypt	1995-2003	NPL has significant negative association with efficiency.
Maghyereh (2004)	Jordan	1985-2001	Banks having higher loan loss provisions are reported to be less efficient.
Fan and Shaffer (2004)	USA	1998	Non-performing loans have negative but insignificant association with banks' profit efficiency.

2.7.5 Internationalization of Banks

The pros of studying this particular variable are invaluable to the managers of developing countries' banks or other medium-sized financial markets owing to the internationalization of operations (Isik & Hassan, 2002). According to Mahajan, Rangan and Zardkoohi (1996), while a large portion of literature has been dedicated to international banking, majority of the analysis was carried out with the help of descriptive tools. One rationale behind this is that majority of the theories explaining the literature on multinational banks, stress on the cost advantages resulting from operating efficiency and production complementarities resulting from foreign expansion. Nevertheless, Aliber (1984) attributes the shortcoming in literature on international banking to an extensive attention to conceptualization and the modest attention to testing. This is further reinforced by Mahajan *et al*. (1996) who state that although the constraint lies in the lack of data availability, the relation between research in domestic and international banking in literature is promising.

Banks having global operations are those with operations in more than a single country. Sometimes, these banks are called foreign banks or are considered in the category of foreign direct investment or FDIs in financial services. On the contrary, international banks are banks operating across international borders but have no physical existence abroad. Banks with global operations can be categorized into two: branch offices and subsidiaries. The former category is a major part of the main branch having no capital of its own; while the latter category is characterized as corporate entities fully owned by the main branch and are merely chartered in the international locations.

In the banking literature, it is found that operating abroad would provide valuable benefits to domestic banks, such as access to advanced skills and technology (Chahine, 2007). Morck and Yeung (1991) find that internationalization of operations through international operationalization of purely domestic banks has advantage that comes from the transference of intangible assets, like technology and reputation, from the home country to subsidiaries. In addition, operational expansion abroad provides banks with the chance to follow their clients and retain them (Williams, 2002). This is clearly a category of firm transfer whereas there is possibility of transfer from one subsidiary to another. Fung *et al*. (2002) examine the experience of the National Australia Bank in establishing subsidiaries in foreign markets, concluding that the National Australia Bank gains the transfer of knowledge and expertise from its subsidiaries in international markets as a result of the senior management exchanges between the respective head offices to promote transfers of new capabilities to the National Australia Bank group. Therefore, it can be stated that banks with international operations may transfer their resources, like technology or employees having the right skills and experience concerning risk management, regulatory and practices of reporting.

Pasiouras (2008) studied the relationship between international operations, i.e., through branches and through subsidiaries and banks' efficiency in Greece. The results show that operations through branches are negatively associated to bank efficiencies, which are significant in terms of technical efficiency approximated through the intermediation method. Operations through subsidiaries, on the other hand, have a positive effect on both technical and scale efficiency; this has similar result for banks with international operations appearing to be more efficient than those operating only at the national level

Table 2.6
Summary of Internationalization of Banks and its Impact on Efficiency

Author (s)	**Country**	**Period**	**Findings**
Pasiouras (2008)	Greece	2000-2004	Operating through branches has significant and negative association with the efficiency (i.e., technical efficiency). Operating through subsidiaries as a variable is positively significant in influencing technical efficiency as well as scale efficiency.
Isik and Hassan (2002)	Turkey	1988-1996	In terms of superiority, the multinational domestic banks are found to be more superior to purely domestic banks in type of all efficiency.
Mahajan *et al*. (1996)	USA	1987-1990	Multinational banks have the ability to reduce inefficiencies than domestic banks, and fully exploit economies of scale.

(Isik & Hassan, 2002) in Turkey. They also report that in terms of efficiency measures, multinational domestic banks are demonstrated to be superior compared to purely domestic banks. These measures, with the exception of scale efficiency, include cost, allocation, technical and pure technical efficiency. In the context of the USA, Mahajan *et al*. (1996) find that multinational banks have the ability to encounter lesser diseconomies brought about by joint production and less inefficiency compared to their domestic banks, and fully exploit economies of scale. Table 2.6 shows the summary of studies related to internationalization of banks and efficiency.

2.7.6 Automated Teller Machines (ATMs)

In the developing countries, the banking sectors' performance has currently been the center of attention in literature, particularly the effect of financial liberalization on the banks' efficiency. However, literature tackling the impact of new technology adoption is sadly lacking although these are generally the results of liberalization and opening up of the banking sector.

ATM utilization has increased significantly in developing countries during the past 15 years. However, despite the wide acknowledgement of benefits that banks could gain by sharing and adoption of such technologies, empirical research on the relationship between ATM utilization and bank efficiency is still limited.

Technology characterized as self-service enables consumers to carry out their transactions whenever, wherever and how they are desirous of doing. While the use of

ATMs in the USA is almost at the peak of saturation, its uses in the other parts of the world are still increasing, particularly in Australia, China, Canada, Germany, the UK and even Yemen. In the context of Yemen, the number of ATMs in 2011 was 502 which constituted an average of about 20 ATMs per million individuals; a significant improvement from 11 ATMs per one million individuals in 2005. The current functions of ATMs in Yemen are cash deposit, cash withdrawal, cash transfer, cash advance as well as account balance checking (CBY, 2011).

Banks obtain greater revenues and maximize their efficiency through offering banking services like ATMs as this will reduce their costs, physical branches and employees (Floros & Giordani, 2008). Self-service technology enables banks to streamline their teller functions, reduce the manual processes and hence, reduce operating costs through getting rid of signature capture and form scanning, etc. It can therefore be stated that ATMs are one of the direct methods of labor substitution and enhancement of operating efficiency (Ou *et al*., 2009).

There have been numerous studies over the past years that examined information technology (IT) investment. For instance, Beccalli (2007) investigated whether investment in IT services influences the performance (measured using both standard accounting ratios and cost and profit efficiency measures) of 737 European banks for the period 1995-2000. He reveals that despite banks being major investors in IT, there is a weak relationship between IT and bank profitability, and also between IT and efficiency. The study concluded that the impact of different types of IT investment on performance of banks is heterogeneous. Shao and Lin (2002) investigated the relationship between IT

and technical efficiency of Fortune 500 firms for the period 1988-1992. The study concluded that IT has a significantly positive influence on technical efficiency.

With regards to bank efficiency and ATMs, few studies have looked at the impact of self-service technology on efficiency (Ou *et al*., 2009; Pasiouras, 2008). However, their results are mixed. For example, Ou *et al*. (2009) find that ATM has positive association with the banks' efficiency. On other hand, Pasiouras (2008) find no statistical significant impact on efficiency of Greek banking. It is argued that the Greece banking system strongly relies on the branches since the distribution of banking network is rising yearly.

The relationship between ATMs and efficiency has been studied in Taiwan by Ou *et al*. (2009) and in Greece by Pasiouras (2008). But, to the best of the researcher's knowledge, not many studies have been conducted in the Republic of Yemen. Table 2.7 shows the summary of these studies.

Table 2.7
Summary of ATMs and its Impact on Efficiency

Author (s)	**Country**	**Period**	**Findings**
Ou *et al*. (2009)	Taiwan	1992-2001	ATM showed positive relationships to efficiency.
Pasiouras (2008)	Greece	2000-2004	ATM failed to show a statistical significant effect on efficiency in any of the specifications.
Beccalli (2007)	European banks	1995-2000	IT investment showed a weak relationship with improved bank profitability and efficiency.
Shao and Lin (2002)	USA	1988-1992	IT revealed a significant positive effect on technical efficiency.

2.7.7 Type of Banks

Islamic banks are proliferating very fast not only in the Islamic countries but throughout the world. For about three decades, since the inception of Islamic banking, there has been an increase in the number of Islamic financial institutions from one in 1975 to over 430 in recent years across the world, particularly in over 75 countries. The concentration of Islamic banks is in the Middle East and Southeast Asia, and in addition, the banks play roles in Europe and the USA (Cihak & Hesse, 2008). In the mid-nineties, Islamic banking showed dramatic improvements and developments in Yemen, and it is given more attention by the government policy although there exist dual banking structures. Many conventional banks are also opening their separate Islamic banking divisions and branches (Akram, Rafique & Alam, 2011). As a result, Islamic banking has improved in terms of number of branches, deposits, capital funds and sources. The ratio of income to expenses is high, indicating a trend of increasing profitability in the sector.

Islamic banks are guided by principles that are distinct from their conventional counterparts. The organization of the Islamic banks and their operations are guided by the principles of Islamic Law (known as Sharia). These principles advocate risk sharing with the prohibition of payment and receipt of interest (known as riba). Conversely, conventional banks operate under the principle of profit-maximization.

Contemporary Islamic banking and finance practices have been criticized time and again (Khan, 2010; Nomani, 2006; Kuran, 2004). The secured, interest-based debt contract in the current times is the basis of conventional banking which has undergone centuries of

operational evolution in an environment characterized as an asymmetric information environment. Hence, Islamic banks, also operating in an asymmetric information environment, would eventually be operating close to the techniques of conventional banking system. This singular aspect may make the Islamic banks to be indistinguishable from the latter (Kuran, 1993). In this case, an analysis of the bank form and operation shows some level of similarities in function between the two types of banks. It is therefore not surprising if Islamic banking becomes virtually indistinguishable from the conventional banking system. One of the striking variations may be in the accounting system which is represented by a classical Arabic terminology favored by Islamic banking and finance advocates.

There should be a distinction between Islamic and conventional banks based on their acquired financial information as shown or stated in their balance sheets and income statements. Nevertheless, because both banks carry out their operations in the same competitive environment and are regulated in the same way in most countries, there is bound to be some similar financial characteristics between them.

Examining efficiency is invaluable to both banking streams and imperative changes, both negative and positive, have manifested throughout the years. Several large foreign conventional banks for instance, have initiated their offer of Islamic banking services. The multiplication of Islamic banks into a large number has led to competition among them. Moreover, Islamic banking practices and knowledge is becoming widespread in a short period of time and as the establishment of Islamic banks increases, the number of

new policies, regulations, as well as accounting standards are increasing to cope with the changes.

Studies concerning Islamic banking efficiency have concentrated on the theoretical issues, and have been described using the descriptive analysis rather than using rigorous statistical estimation (El-Gamal & Inanoglu, 2004). Despite the soundness of the theoretical base of the positive relationship between Islamic banks and efficiency, there is no conclusive empirical evidence in this respect (Mohamad *et al*. 2009). For example, Olson and Zoubi (2011) state that the conventional banks will be encouraged to broaden their operational activities to cover Islamic products due to the observed profitability of Islamic banks. Noor *et al*. (2010) mention that in countries with high income, Islamic banks led and dominated the most efficient frontier over the period covering 2003-2009.

Alsarhan (2009) investigated the link between the Islamic banks and technical efficiency of banks in GCC over the period 2000-2007. Consistent with prior research by Hussein (2004) and Al-Jarrah and Molyneux (2003), Alsarhan (2009) reports that the relationship between the Islamic and the technical efficiency score is a significant positive relationship.

In a contrasting study, Hassan (2005) carried out an examination of the cost, allocative, technical, pure technical and scale efficiency of Islamic banks in 21 countries around the world, and revealed that Islamic banking industry is not as efficient as its counterparts for the period 1995-2001. Moreover, using DEA, and a sample consisting of 40 banks across 11 Islamic countries over the period 1990-2005, Mohamad *et al*. (2009)

investigated whether there is significant difference in the mean scores of variables (e.g., cost, revenue and profit efficiency) between the conventional and the Islamic banks. Findings show that the overall efficiency of Islamic banks did not differ significantly from the conventional banks. In a recent study, Rosman, Wahab and Zainol (2013) applied DEA to 79 Islamic banks that operated in the Middle Eastern and Asian countries. It was reported that most of these Islamic banks were scale inefficient, and majority of the banks that were scale inefficient operated under decreasing returns to scale.

Islamic banking has been investigated in some countries of the world over the last few years as shown in Table 2.8. In the GCC context, Alsarhan (2009), Hassan (2005), Hussein (2004) and Al-Jarrah and Molyneux (2003) conducted their studies on Islamic bank efficiency. While in the Middle East and North African context, the efficiency research was done by Olson and Zoubi (2011). However, based on the available studies reviewed, the researcher is of the knowledge that studies relating to this issue has not been conducted in Yemen before. Table 2.8 indicates the results of the studies concerning the relationship between Islamic banks and efficiency.

Table 2.8
Summary of the Type of Banks and its Impact on Efficiency

Author (s)	**Country**	**Period**	**Findings**
Rosman *et al*. (2013)	Middle Eastern and Asian countries	2007-2010	Most of these Islamic banks were scale inefficient, and majority of the banks that were scale inefficient operated under decreasing returns to scale.
Mohamad *et al*. (2009)	11 Islamic countries	1990-2005	The overall efficiency of Islamic banks did not significantly differ from that of conventional banks.
Alsarhan (2009)	GCC	2000-2007	There is significant positive relationship with efficiency.
Hassan (2005)	The Islamic banks in 21 countries	1995-2001	Findings reveal that the Islamic banking industry is relatively less efficient in comparison to the conventional banking industry in the rest of the world.
Hussein (2004)	Bahrain	1985-2001	The Islamic banks outperform their conventional counterparts.
Al-Jarrah and Molyneux (2003)	MENA	1992-2000	With respect to Islamic banks and investment banks, the former are found to be most efficient while the latter are least efficient.

2.7.8 Intellectual Capital Performance (ICP)

Intellectual capital is viewed as one of the most important resources which banks rely on to improve their efficacy and efficiency, and hence gain a competitive advantage (El-Bannany, 2008; Kamath, 2007; Goh, 2005). The importance of intellectual capital to banks stems from the fact that banking industry is a knowledge-intensive industry (Shih *et al*., 2010) since the nature of its main resources are intangible and intellectual and these assets are more important than physical capital in the process of wealth creation (Al-Bannany, 2008; Kamath, 2007; Goh, 2005). As pointed out by Goh (2005), banks essentially rely upon physical capital for their operations, but the services quality and products provided by them to their customers ultimately rely on intellectual capital. Therefore, banks are able to become more competitive and face the changes in their competitive environment by focusing more on creating IC, such as knowledge, competence and intellectual property (Teece, Pisano & Shuen, 1997).

Engstrom, Westnes and Westnes (2003) claim to the lack of a unanimous definition of intellectual capital although its definitions provided by the researchers are not divergent as most of the definitions display similar words like knowledge, skills, know-how, experiences, intangible assets, information, processes and value creation (Ku Ismail & Abdul Kareem, 2011). For instance, Edvinsson and Sullivan's (1996) definition of intellectual capital regards it as knowledge that can be converted into value. They add that this definition is broad and it covers inventions, ideas, general knowledge, designs, computer programs, data processes and publications. On the other hand, Edvinsson and Malone (1997) define it as, "*the possession of the knowledge, applied experience,*

organizational technology, customer relationships and professional skills that provide a company with a competitive edge in the market".

There is unanimity among the researchers that intellectual capital covers human capital, structural capital and relational capital (Edvinsson & Malone, 1997; Pulic, 1998). According to the Institute of Certified Management Accountants (ICMA, 2001), human intellectual capital (HIC) encompasses knowledge, professional skill and experience, and employee creativity. Structural intellectual capital (SIC) comprises innovation capital which are intellectual assets like patents, and process capital which are organizational procedures and processes. On the other hand, relational intellectual capital (RIC) of intellectual capital covers knowledge regarding market channels, the relationships between customer and supplier as well as governmental or industry networks. Therefore, intellectual capital entails the acquisition of skills, professional knowledge, experience, technological capacities and good relationships. The application of these qualities has the potential of providing or gaining competitive advantage for the organizations.

Although there is a significant acknowledgement of intellectual capital's role in obtaining firm value and competitive advantage, researchers have not come up with an acceptable measure of IC. Goh (2005) states that there are over twenty methods of IC measurement, such as Calculated Intangible Value (CIV) Market-to-Book (MTB), Economic Value Added (EVA), Balanced Score Card (BSC), and Value Added Intellectual Coefficient (VAIC); the last of which is proposed by Pulic (Ku Ismail & Abdul Karem, 2011).

The VAIC proposed by Pulic (1998) is quite notable as a new tool for management and control that was developed for the monitoring and measuring of intellectual capital, performance of capital and potential of firm by the organizations (Kamath, 2007). VAIC does not measure the intellectual capital of the firm directly but measures the value added (VA) efficiency through corporate intellectual ability. According to Pulic (2000), the key components of VAIC are noticeable from the resources-based capital of the firm used, human and structural capital. The first form of capital (resource-based capital) is tangible and the latter two are intangibles. VAIC primarily determines the total efficiency of value creation from tangible as well as intangible employed resources.

Many studies have made use of the VAIC model as their main IC measurement. Nevertheless, a thorough look at literature reveals that no previous study has dealt with the link between IC performance and Yemeni bank efficiency. Among the studies which made use of VAIC is Chen, Cheng and Hwang's (2005) study where the model was used in the investigation of the link between firms' IC and market-to-book value ratios. The authors carried out an analysis in order to know whether IC adds to the financial performance of the firm and to know whether it is possible to use IC as a foremost indicator for financial performance in the future. Their study involved the whole listed firms in the Stock Exchange of Taiwan for the year covering 1992 to 2002. The findings revealed that the market value of the firms and their financial performance has positive relationship with the corporate intellectual ability and that intellectual capital could be used to indicate the future financial performance of the firms.

Several studies have adopted VAIC in the examination of bank performance. Included in these studies Pulic's (1997, 2002) that attempted to measure the performance of intellectual capital of banks in Austria over the period covering 1993 to 1995 and that of banks in Croatia over the period 1996 to 2000. The author concluded that in terms of efficiency and performance of the banks, there was significant difference in the ranking of the banks.

In Malaysia, Goh (2005) measured the commercial banks' intellectual capital performance over the period 2001 to 2003. Findings revealed that for both domestic and foreign banks in Malaysia, value creation capability is to a large extent attributable to the efficiency of human capital. It is further indicated that there is higher return realized from human capital investment compared to investment in the other two constituents (physical and structural capital) of VAIC. Appuhami (2007) investigated how the value creation efficiency has impacted on the capital gains of the investors on shares by using a sample of 33 listed Thailand banks, insurance, and finance companies in the year 2005. Findings showed that the intellectual capital of the firms is positive and significantly associated with the capital gains of the investors on shares. In Turkey Yalama and Coskun (2007) investigated the association of intellectual capital performance with the banks' profitability over the period covering 1995-2004. It was indicated that for banks, IC plays amore important role more than physical capital.

Furthermore, several studies have adopted VAIC to study bank performance on numerous countries' context, such as Mavridis (2004) in Japan and Mavridis and Kyrmizoglou (2005) in Greece, in which their findings were consistent with Yalama and

Coskun's (2007) findings. Moreover, in the context of India, Kamath (2007) made use of VAIC in his measurement of the value based performance of the Indian banking sector from 2000-2004. The study stated the existence of highly significant differences in Indian banks' performance in various sectors. Improvement was shown in the overall performance during the period of study. In addition, Ku Ismail and Abdul Karem (2011) employed the VAIC model to study a sample of 18 listed banks for a period of three years (2005 to 2007) and reported that the financial performance of the banks as measured by ROA was positively impacted by IC. Recently, Al-Musali, Al-Attifie, Rus and Ku Ismail (2013) investigated the associations of IC with the financial performance indicators of the banks during the period 2006-2011. The authors found that IC has positive relationship with the financial performance indicators of the bank measured by ROA and ROE.

On the other hand, Firer and Williams (2003) made use of the VAIC method in their examination of the intellectual capital relationship with the traditional measures of corporate performance, such as profitability comprising ROA, productivity comprising turnover of total assets and finally market value comprising of market-to-book value ratio of net assets in the context of South Africa. Results of the study indicated that the efficiency of capital used was positive and significantly related to the firms' market value. The empirical results never reported any strong connection among the three factors of value-added efficiency with the three dependent variables considered for study. A more recent study in Yemen by Al-Musali *et al*. (2013) found that when VAIC is split into three components, the relationships between the components and bank financial performance indicators were varied.

Table 2.9
Summary of Intellectual Capital Performance (ICP) on Performance

Author (s)	**Country**	**Period**	**Findings**
Al-Musali *et al*. (2013)	Yemen	2006-2011	ICP has a positive relationship with financial performance. However, the components of VAIC shows mix findings with financial performance.
Ku Ismail and Abdul Karem (2011)	Bahrain	2005-2007	ICP is positively related with the financial performance.
Yalama and Coskun (2007)	Turkey	1995-2004	Concluded that Intellectual Capital is more important than physical capital for banks.
Kamath (2007)	Indian	2000-2004	Concluded there are vast differences in the value creation performance of Indian banks.
Appuhami (2007)	Thailand	2005	ICP is positive and significantly related to investors' capital gains on shares.
Chen *et al*. (2005)	Taiwan	1992-2002	ICP is positively associated with market value as well as financial performance

Table 2.9 (Continued)

Author (s)	Country	Period	Findings
Mavridis and Kyrmizoglou (2005)	Greece	1996-1999	Significant and positive relationship exists between ICP and financial performance.
Mavridis (2004)	Japan	2000-2001	The relationship between ICP and financial performance is positive.
Firer and Williams (2003)	South Africa	2001	Showed that there were generally limited and mixed relationships between the efficiency of value added by a firm's major resource bases and profitability, productivity and market valuation.
Pulic (1997, 2002)	Austria and Croatia	1993-1995 1996-2000	The relationship between ICP and financial performance is significant and positive.

A review of literature reveal that there is no study that has been done on the examination of the influence of intellectual capital on bank efficiency since the focus of previous studies was on financial performance of a bank. Table 2.9 shows above the summary of studies.

2.8 Summary

This chapter reviewed relevant literature relating to the study variables (i.e., bank size, profitability, non-performing loans, financial capital, ATMs, type of banks, internationalization of banks, intellectual capital performance). In so doing, the chapter was divided into various sections. In section 1, objectives of the conceptual framework for the bank efficiency was elaborated. Next, an extensive review of extant empirical researches was conducted towards the development of the research model. Then, to link the study's variables, six major theoretical perspectives were considered, namely; divisibility, shakeout, moral hazard, bad management, eclectic and resource-based theories. In the next chapter, the research methods adopted in the present study are explained.

CHAPTER THREE
METHODOLOGY

3.1 Introduction

In this chapter, a framework to measure bank efficiency through the use of DEA is presented in Section 3.2. The definitions of inputs and outputs specified as used in the efficiency evaluation are provided in Section 3.3. Section 3.4 presents the hypotheses formation and Section 3.5 presents the measurements of explanatory variables. Section 3.6 explains how Tobit regression model estimates the determinants of efficiency on the basis of specific bank factors**.** The sample, data and its sources are discussed in section 3.7. The last section summaries the chapter.

3.2 Measurement of Bank Efficiency

There are various methods of measuring efficiency of banks. Some of these methods include the parametric approach that was discussed earlier. In this study, non-parametric Data Envelopment Analysis (DEA) model is adopted because the technique has many advantages as discussed previously in chapter two.

3.2.1 Data Envelopment Analysis

A non-parametric DEA is employed with variable returns to scale (VRS) assumption to measure input-oriented for technical efficiency of Yemeni banks. This methodology has been used by many studies (Havrylchyk, 2006; Pasiouras, 2008; Sufian, 2009; Noor *et al*., 2010). DEA entails the construction of a non-parametric production frontier on the

basis of the actual input-output observation in the sample as related to each firm's efficiency measured in the sample (Coelli, 1996). The discussion of DEA begins with a description of the input-orientated constant returns to scale (CRS) model. The model was developed by Charnes *et al*. (1978).

Suppose that data is available for individual N bank on K inputs and M outputs. The vectors x_i and y_i, accordingly represent the ith bank. Let input matrix X be represented by $K * N$ while output matrix Y be represented by $M * N$. In order to measure each bank's efficiency, the ratio of all outputs to inputs (given as $u'y_i/v'x_i$) are calculated, in which case u stands for a $M * 1$ vector of output weights while v stands for a $K * 1$ vector of input weights. For the selection of optimal weights, the programming problem is specified as follows:

$$\min_{u,y}(u'y_i/v'x_i),$$
$$u'y_i/v'x_i \leq 1, \quad i = 1, 2, \ldots\ldots n, \; u, v, \geq 0$$

The above formulation has problem of infinite solutions. To avoid it, one can impose the constraint $v'x_i = 1$, which leads to

$$\min_{\mu,\varphi} (\mu'y_{i)},$$
$$\varphi'x_i = 1,$$
$$\mu'y_i - \varphi'k_j \leq 0, \quad i = 1, 2, \ldots\ldots, N,$$
$$\mu, \varphi \geq 0$$

Where this study changes notation from u and v to μ and φ, respectively. In order to reflect transformations, an equivalent envelopment form can be derived:

$$\min_{\theta, \lambda} \theta,$$
$$y_i + Y\boldsymbol{\lambda} \geq 0,$$
$$\theta x_i - X\boldsymbol{\lambda} \geq 0,$$
$$\boldsymbol{\lambda} \geq 0$$

From the foregoing equation, θ represents a scalar which is the efficiency score value for the *i*th bank and which varies or lies between 0 and 1. A vector of $N * 1$ constants is represented by $\boldsymbol{\lambda}$. The number of times the linear programming is to be solved for individual sampled bank is one and for the whole sampled bank, N times. For the calculation of efficiency given the VRS presumption, the addition of convexity constraint ($N1'\boldsymbol{\lambda} = 1$) is done to ensure the comparison of a bank which is not efficient with other banks having the same size, and thus come up with the justification for the measurement of economies of scale using the concept of DEA. The extent to which the observed combinations of input and output are enveloped by production frontier is determined by convexity constraint, but there is no such imposition in the case of CRS. Therefore, the method of variable returns to scale creates a convex hull that securely covers the data compared to CRS and offers a more efficient score more than or equal to the scores acquired through its counterpart model. In the case of CRS and VRS, scale efficiency can be found from their respective ratio of technical efficiency to pure technical efficiency. The scale efficiency (SE) is defined by

$$SE = \frac{TE_{CRS}}{TE_{VRS}} \qquad \text{……..…….. 3.1}$$

However, the scale efficiency measure does not show whether the concerned DMU is operating under the condition of increasing returns to scale (IRS) or decreasing returns to scale (DRS). In order to point out the form of returns to scale, comparison is made between the scores associated with CRS and VRS. For example, a bank is operating under the assumption of constant returns to scale (CRS) if the score for VRS equals that of CRS. In a case where the scores for VRS and CRS are not equal, then it can be established whether the operation of the bank is under the assumption of IRS or DRS. In order to pursue this, the DEA model is employed under the assumptions of non-increasing returns to scale (NIRS). Thus, a bank is operating under the DRS assumption in a case where the score of VRS equals that of NIRS (As is the case for the point G in Figure 3.1). On the other hand, a bank is operating under the assumption of IRS in a case where the score for VRS differs from that of NIRS (As is the case for the point P in Figure 3.1).

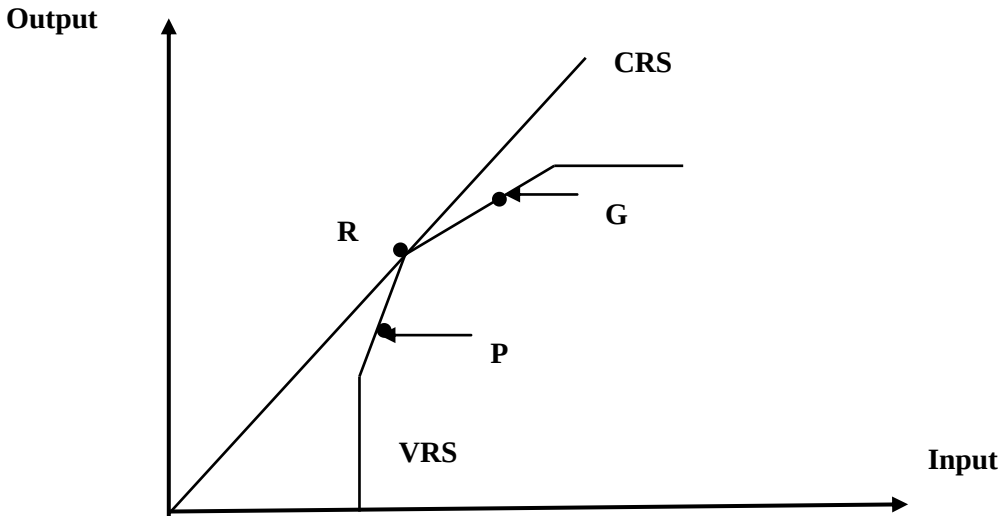

Figure 3.1
Measurement Scale Efficiency
Source: Coelli *et al*., (1998)

3.3 Process of Identifying Input and Output

The present study chooses the intermediation approach to determine both outputs and inputs, as there is an absence of data regarding the number of deposits and loan accounts. Furthermore, this approach has been widely used in the efficiency literature.

Similar to many studies on banking efficiency, (Sufian, 2009; Moffat, 2008), the inputs for this study include labor (salaries), capital (represented by the value of fixed assets) and deposits (represented by customers' deposits, call deposits, or current accounts). The relevant outputs are interest-related revenues and non-interest revenues emanating mostly from commission, exchange, brokerage and others. The outputs include loans (total loans) and investments (represented by banks' securities, investment funds and stocks). The inputs and outputs used in the DEA model are illustrated in Figure 3.2.

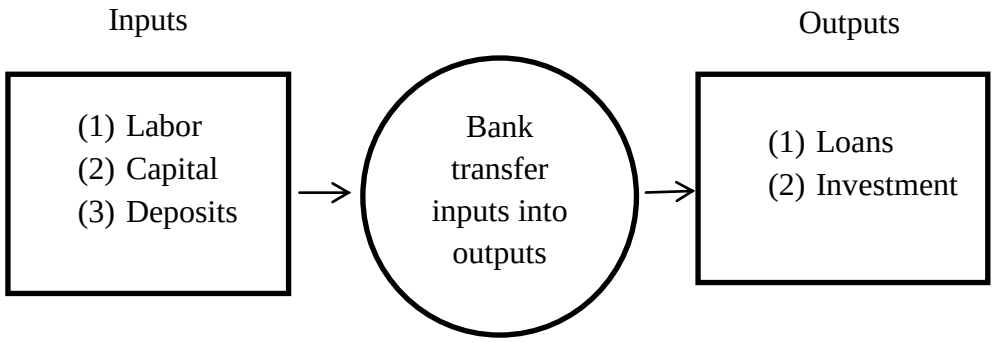

Figure 3.2
The Three Inputs and Two Outputs Used in the DEA Model.

3.4 Hypotheses Development

The second part of the study is to find the determinants of technical, pure technical and scale efficiency. Based on the argument provided in literature review, the following hypotheses are suggested.

3.4.1 Size

Various studies have been dedicated to bank size but no unanimous result has emerged regarding its link to efficiency (Harrylchyk, 2006; Avkiran, 1999). Reda and Isik (2006), Ataullah and Le (2006) and Maghyereh (2004) find a positive relationship between size and bank efficiency, while Isik and Hassan (2002) show a negative relation between the two. Overall, the findings reinforced by various studies (Hermalin & Wallace, 1994; Kaparakis *et al*., 1994; DeYoung & Nolle, 1998) claim that efficiency measures favor no potential biases in terms of size. In addition, this variable is in line with the divisibility theory and shakeout theory. Therefore, the hypothesis is developed as follows:

H1: There is a relationship between bank's size and efficiency.

H1a: There is a relationship between bank's size and technical efficiency.

H1b: There is a relationship between bank's size and pure technical efficiency.

H1c: There is a relationship between bank's size and scale efficiency.

3.4.2 Profitability

There have been numerous studies in the past years that examined profitability and efficiency. Most of the studies showed positive relationship between the variables

(Moussawi & Obeid, 2011; Alsarhan, 2009; Sufian, 2009; Pasiouras, 2008). All these researchers found that profitability significantly influences efficiency. However, several researchers have also reported mixed finding over the years. Ataullah and Le (2006) and Casu and Girardone (2004) found that profitability affected efficiency negatively. Therefore, the hypothesis is developed as follows:

H2: There is a relationship between profitability and efficiency.

H2a: There is a relationship between profitability and technical efficiency.

H2b: There is a relationship between profitability and pure technical efficiency.

H2c: There is a relationship between profitability and scale efficiency.

3.4.3 Financial Capital

Numerous studies have examined whether financial capital influences efficiency. For instance, Pasiouras (2008), Rao (2005), Casu and Girardone (2004) and Isik and Hassan (2003) found positive relationship between financial capital and efficiency, while Sufian (2009), Chan (2008) and Maghyereh (2004) found a negative relationship. On the other hand, Havrylchyk (2006) and Reda and Isik (2006) found no relationship between capitalization and efficiency. Therefore, based on the theory of moral hazard and consistent with previous studies, the following hypothesis is proposed:

H3: There is a relationship between financial capital and efficiency.

H3a: There is a relationship between financial capital and technical efficiency.

H3b: There is a relationship between financial capital and pure technical efficiency.

H3c: There is a relationship between financial capital and scale efficiency.

3.4.4 Non-performing Loans

The Berger and DeYoung's (1997) 'bad management' hypothesis provides suggestions that increasing non-performing loans will commonly worsen the financial institutions' efficiencies because of the increasing expenditure involved to monitor, administer and sell-off the loans. Prior researches examined whether loans' loss provisions influence efficiency and provided evidence of the negative association between non-performing loans and efficiency (e.g., Sufian, 2009; Moffat, 2008; Reda & Isik, 2006; Harrylchyk, 2006; Maghyereh, 2004). Therefore, based on the bad management hypothesis and consistent with previous studies, the following hypothesis is proposed:

H4: There is negative relationship between non-performing loans and efficiency.

H4a: There is negative relationship between non-performing loans and technical efficiency.

H4b: There is negative relationship between non-performing loans and pure technical efficiency.

H4c: There is negative relationship between non-performing loans and scale efficiency.

3.4.5 Internationalization of Banks

According to Pasiouras (2008), studies regarding bank operations abroad through both branches and subsidiaries, present mixed findings. Bank operations abroad through branches have a negative link to bank efficiency wherein its significance lies in cases of technical efficiency approximated through the intermediation approach. On the other hand, bank operations through subsidiaries have a positive effect on both technical and scale efficiency. Moreover, Isik and Hassan (2002) state that bank operations abroad have a positive effect on technical efficiency. However, the effect in terms of the scale efficiency is not supported. Therefore, it can be said that the studies regarding international operations present findings that are consistent with the eclectic theory of international production (e.g., Dunning, 1977; Gray & Gray, 1981), and therefore the hypothesis is developed as follows:

H5: There is a relationship between banks with international operations and efficiency.

H5a: There is a relationship between banks with international operations and technical efficiency.

H5b: There is a relationship between banks with international operations and pure technical efficiency.

H5c: There is a relationship between banks with international operations and scale efficiency.

3.4.6 Automated Teller Machines (ATMs)

Despite the sound theoretical basis for expecting a positive relationship between technology and efficiency, prior research has shown mixed results. Ou *et al*. (2009) found ATM intensity confirming the hypothesis that ATM intensity positively impacted banks' efficiency, while Pasiouras (2008) revealed that ATMs lacked a statistical significant effect upon bank efficiency. Therefore, the hypothesis is developed as follows:

H6: There is a relationship between the Automated Teller Machines (ATMs) and efficiency.

H6a: There is a relationship between the ATMs and technical efficiency.

H6b: There is a relationship between the ATMs and pure technical efficiency.

H6c: There is a relationship between the ATMs and scale efficiency.

3.4.7 Type of Banks

For the Islamic banking variable, a few studies have examined this variable's association with efficiency. Hassan (2005) studied all efficiency measures of Islamic banks throughout the world. He concluded that the Islamic banking industry is relatively less efficient compared to its conventional counterparts. But other studies, such as Alsarhan (2009), Hussein (2004), and Al-Jarrah and Molyneux (2003), reported a significant positive relationship between the Islamic banks and the technical efficiency score. Thus, the hypothesis is developed as follows:

H7: There is a relationship between the type of banks and efficiency.

H7a: There is a relationship between the type of banks and technical efficiency.

H7b: There is a relationship between the type of banks and pure technical efficiency.

H7c: There is a relationship between the type of banks and scale efficiency.

3.4.8 Intellectual Capital Performance

Several studies have examined VAIC and its effects on performance. For example, the study by Chen *et al*. (2005) suggests that the investment in human capital relatively results in a higher return compared to investment in physical and structural capital. In their study, Yalama and Coskun (2007) noted that in terms of intellectual capital and physical capital relevance to banks, the former is more important than the latter in determining the banks' performance. This result is in line with the results obtained by Mavridis (2004) and Mavridis and Kyrmizogou (2005). Kamath (2007) measures the performance of the banking sector in India on the basis of their added value by using VAIC. His finding suggests that there is enormous difference in the Indian banking sector's performance in various segments. A related study by Al-Musali *et al*. (2013) and Ku Ismail and Abdul Karem (2011), found that IC has positive impact on the financial performance of banks in Yemen and Bahrain respectively. On the contrary, Firer and Williams (2003) failed to find a link among the three value-added efficiency components and the firm performance indicators with the exception of the significant link between employed efficiency and market value of firms. However, the emphasis of prior research was on the impact of IC on firm performance in terms of profitability and

market value, ignoring its impact on firm performance in terms of efficiency. Therefore, based on the resource-based view, the hypothesis is developed as follows:

H8: There is a positive relationship between Intellectual Capital (IC) performance and efficiency of banks in Yemen.

H8a: There is a positive relationship between IC performance and technical efficiency.

H8b: There is a positive relationship between IC performance and pure technical efficiency.

H8c: There is a positive relationship between IC performance and scale efficiency.

3.4.9 Control Variables

Consistent with previous studies (Sufian, 2009; Reda and Isik, 2006), this study uses two dummy variables to control for the impact of foreign bank ownership (FOR Banks) and local private ownership (LPR Banks) on efficiency. FOR Banks is a dummy variable, used to examine the relationship between foreign bank ownership with efficiency. It takes a value of 1 for foreign banks, 0 otherwise. A positive relationship is expected. LPR Banks is a dummy variable, used to examine the relationship between private bank ownership with efficiency. It takes a value of 1 for private bank ownership, 0 otherwise. A positive relationship is expected.

Furthermore, the global financial crisis in 2008 which began late 2007 in the USA, has widely impacted on the operations and the financial performances of a large number of banks worldwide (Hidayat & Abduh, 2012; Ellaboudy, 2010; Smolo & Mirakhor, 2010; Kassim & Majid, 2010). Consequently, a large number of banks worldwide have recorded financial loss as provided in their financial reports. This was as a result of their links to the subprime mortgage in the USA, or due to the impacts of their own countries' economic recession. The CBY (2011) pointed out that Yemen was not affected directly by the global financial crisis which had swept stock markets and banks across the world. However, the banks in Middle East countries in general, and Yemen in particular, are not in the medium or long term resistant to the crisis. The connections of Middle East countries to the world economy imply that their growth strongly depends on European economies' influences. Therefore, it is imperative to examine the efficiency of banks during the crisis period. It is essential to investigate this because having the knowledge of the magnitude of the crisis' effect on the banking sector could be useful to policy makers to formulate and implement policy measures with precision and to guide on whether to make bank supervision and regulations tighter. Based on the above discussion, this study expects that global financial crisis has no relationship with bank efficiency in Yemen.

In addition, following previous studies (e.g., Chan, 2008; Sufian *et al*., 2007; Wong, Fong, Wong and Choi, 2007), this study uses the economic growth variable to control for the effect of economic conditions on Yemeni banks' efficiency. The gross domestic product (GDP) growth rate, which is a widely accepted measure of economic growth

(Chan, 2008; Sufian & Abdul Majid, 2007) is used as a measure of economic growth in this study.

Generally, in the banking system, GDP has been argued to have effect on the demand and supply of deposits, as well as on the demand and supply of loans. An improvement in GDP shows that there will be more savings and deposits in the economy since in a prospering economy, the economic units earn more. Therefore, with economic expansion, banks benefit from the increased financial services demanded, reduction in loan defaults and consequently, an increase in output. Thus, a positive association between economic growth and bank efficiency is expected. Figure 3.3 presents the theoretical framework for the study.

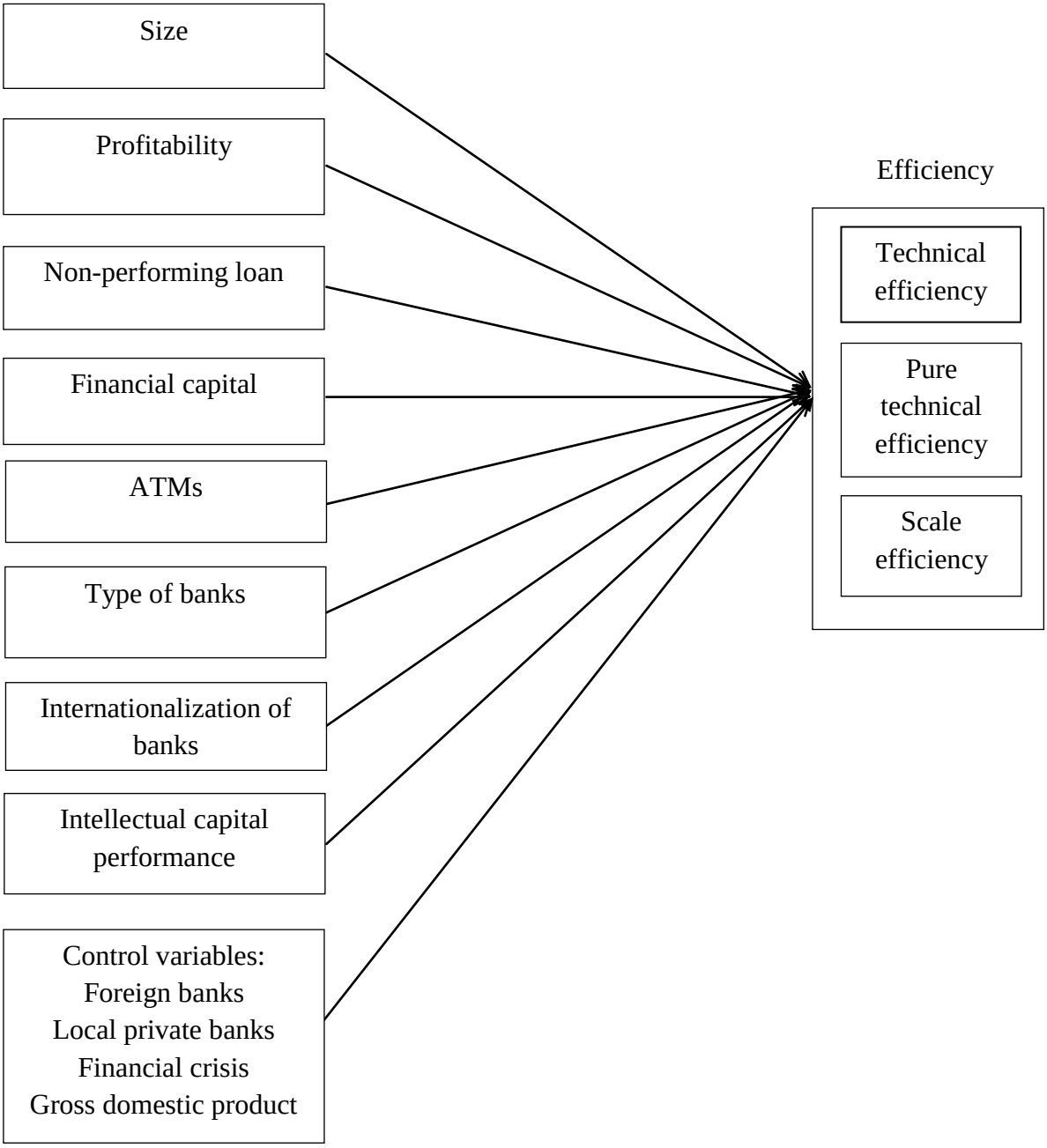

Figure 3.3
Theoretical Framework

3.5 Measurements of Explanatory Variables

Table 3.1 summarizes the operationalization of the variables used in this study.

Table 3.1
Measurements of Explanatory Variables

Variables	Notation	Measurement	Supports
Size	BSIZE	Natural log of total assets	Maghyereh (2004), Isik and Hassan (2002), Ataullah and Le (2006)
Profitability	ROE	Net income to total equity	Alsarhan (2009), Chan (2008)
Non-performing loans	NPL	Total loan loss provision to total loan	Havrylchyk (2006), Sufian (2009), Reda and Isik (2006)
Financial capital	FINCP	Total equity to total assets	Pasiouras (2008), Reda and Isik (2006), Rao (2005)
Automated Teller Machines	ATMs	Natural log of the number of bank's ATMs	Pasiouras (2008)
Type of banks	TYPE	Dummy variable equals to 1 if the bank is Islamic, 0 for conventional banks	Olson and Zoubi (2011), Alsarhan (2009), Al-Jarrah and Molyneux (2003)
Internationalization of banks	INTSU	Dummy variable that equals 1 if the bank has subsidiaries abroad and 0 otherwise	Pasiouras (2008), Isik and Hassan (2002)
Intellectual capital performance	ICP	Value Added Intellectual Coefficient (VAIC)	Al-Musali *et al*. (2013), Ku Ismail and Abdul Karem (2011), Kamath (2007), Goh (2005), Pulic (1997,1998)
Foreign Banks	FOR Banks	It takes a value of 1 for foreign banks, 0 otherwise	Sufian (2009), Reda and Isik (2006)

Table 3.1 (Continued)

Variables	Notation	Measurement	Supports
Local Private Banks	LPR Banks	It takes a value of 1 for private bank ownership, 0 otherwise.	Sufian (2009), Reda and Isik (2006)
Financial crisis	Crisis	A dummy variable equals 1 for a period of financial crisis (2008-2009) and 0 otherwise.	Hidayat and Abduh (2012)
GDP growth	GDP	Growth rate of the gross domestic product	Moussawi and Obeid (2011), Wong *et al*. (2007)

3.6 Two-Stage Approach

In order to find the determinants of efficiency, this study uses the two-stage approach as suggested by Coelli *et al*. (1998). The two-stage approach is the most prominent approach in the efficiency studies. Under this approach, the efficiency score from the DEA (first stage analysis) model is used as the dependent variables in the second stage analysis, which is the Tobit regression. The Tobit regression analysis is carried out because the efficiency scores lie within the range of 0 and 1. The following models are estimated:

$$Teff = \beta_1 BSIZE + \beta_2 ROE + \beta_3 NPL + \beta_4 FINCP + \beta_5 INTSU + \beta_6 ATMs + \beta_7 TYPE +$$

$$\beta_8 ICP + \beta_9 FOR\ Banks + \beta_{10} LPR\ Banks + \beta_{11} Crisis + \beta_{12} GDP + \varepsilon i \quad \ldots\ldots\ldots\ldots\ldots\ldots 3.2$$

$$PETff = \beta_1 BSIZE + \beta_2 ROE + \beta_3 NPL + \beta_4 FINCP + \beta_5 INTSU + \beta_6 ATMs + \beta_7 TYPE + \beta_8 ICP + \beta_9 FOR\ Banks + \beta_{10} LPR\ Banks + \beta_{11} Crisis + \beta_{12} GDP + \varepsilon i \quad \ldots\ldots\ldots\ldots\ldots\ldots 3.3$$

$$SEff = \beta_1 BSIZE + \beta_2 ROA + \beta_3 NPL + \beta_4 FINCP + \beta_5 INTSU + \beta_6 ATMs + \beta_7 TYPE + \beta_8 ICP + \beta_9 FOR\ Banks + \beta_{10} LPR\ Banks + \beta_{11} Crisis + \beta_{12} GDP + \varepsilon i \quad \ldots\ldots\ldots\ldots\ldots\ldots 3.4$$

Where;

TEff = technical efficiency score

$PETff$ = pure technical efficiency score

SEff = scale efficiency score

BSIZE = bank size

ROE = return on equity

NPL = non-performing loan

FINCP = financial capital

INTSU = dummy variable for internationalization of banks

ATMs = automated teller machines

TYPE = dummy variable for type of banks

ICP = Intellectual capital performance

FOR Banks = foreign banks

LPR Banks = local private banks

Crisis = financial crisis

GDP = GDP growth.

In order to measure ICP, this study used value added intellectual coefficient (VAIC). VAIC is a composite sum of three separate indicators, which are capital employed efficiency (CEE), is an indicator of VA efficiency of capital employed, human capital efficiency (HCE), is an indicator of VA efficiency of human capital, and structural capital efficiency (SCE), is an indicator of VA efficiency of structural capital.

The following equation formalizes the relationship algebraically:

$$VAIC = CEE + HCE + SCE$$

Where;

VAIC = VA intellectual coefficient for bank;

CEE = VA / CE*;* VA capital employed coefficient for bank*;*

HCE = VA / HC*;* human capital coefficient for bank*;* and

SCE = SC / VA*;* structural capital VA for bank*;*

CE = book value of the net assets for bank;

HC = total investment salary and wages for bank*;*

SC = VA – HC; structural capital for bank*;*

Value added (VA) is calculated as follows:

VA = OUTPUT – INPUT

OUTPUT is the total revenue realized in a fiscal year by an organization while INPUT is the operating expenses excluding employees' costs. This concept of VA treats the employees-related expenditures as an investment (Pulic, 1998; 2004).

It is worth to mention that simple linear regression model is found to be inappropriate in the current study due to the fact that the range of efficiency scores found from DEA

model is censored and for this reason, applying ordinary least squares technique could lead to biased estimates if the observations' significant position equal to one (Resende, 2000). In that condition, the regression model that is considered appropriate is Tobit or censored regression model that addresses the skewed and truncated data (Avkiran, 1999).

3.7 Sample and Data Sources

The study uses secondary data for Yemeni banks obtained for the period from 1998 to 2011. The sample consists of three state-owned banks, four private foreign banks and seven local banks. The data is extracted from each bank's annual financial statement. The data sets are from the Central Bank of Yemen. Due to inaccessibility of some of the annual reports and incomplete data in some, the final sample consists of 177 bank-years. The period is chosen due to two reasons. First, most of the data is available in this period. Second, financial reform which is imposed by the government started in 1998.

3.8 Summary

Generally, this chapter focuses on the method used in the analysis. Specifically, the methods used are the DEA analysis and the Tobit regression. The input and output used in DEA are discussed together with the variables used in the Tobit regression. The DEA is used to decompose various types of efficiencies which are technical, pure technical and scale efficiencies, for the purpose of identifying the key source of banks' inefficiency. Next, variables and hypotheses are discussed. Finally, the measurement of variables employed is highlighted based on literature review.

CHAPTER FOUR

EMPIRICAL RESULTS AND DISCUSSION

4.1 Introduction

In this chapter, the findings obtained from the analyses of technical, pure technical and scale efficiencies for Yemeni banking from year 1998 to 2011 are discussed. The descriptive statistics of input and output variables are presented in section 4.2. Section 4.3 presents the results of DEA. Section 4.4 presents the descriptive statistics of independent variables. Then, Section 4.5 discusses on the assumptions of Tobit regression analysis. Section 4.6 highlights the results of Tobit regression model. Tests of the robustness of the main results are presented in Section 4.7. Finally, Section 4.8 presents some concluding remarks.

4.2 Descriptive Statistics of the Input and the Output Variables

Before presenting the DEA results on technical, pure technical and scale efficiencies of the banking sector in Yemen, Table 4.1 presents the descriptive statistics of the output and input variables used to construct the DEA model.

Table 4.1

Descriptive Statistics for Inputs and Outputs Used in DEA (RY Millions)

Years	Mean Std Dev	Labor	Capital	Deposits	Loans	Investments
1998	Mean	212,436.82	293,465.87	9,924,523.85	3,598,695.14	6,558,035.02
	Std Dev	286,560.39	502,992.39	11,470,938.01	2,938,772.95	8,668,864.31
1999	Mean	263,167.48	488,137.88	16,629,510.95	4,126,353.85	8,121,085.52
	Std Dev	280,107.44	502,992.39	15,264,605.55	3,493,320.12	9,480,969.24
2000	Mean	284,817.47	541,077.30	17,365,169.25	4,972,916.76	12,344,199.45
	Std Dev	283,204.63	506,377.59	18,796,091.97	4,712,548.62	12,252,432.06
2001	Mean	335,543.23	549,289.35	22,667,393.60	6,076,100.53	15,315,362.51
	Std Dev	294,725.05	494,010.81	21,956,356.03	5,503,125.60	16,425,933.11
2002	Mean	335,661.25	643,740.17	26,785,290.31	6,449,170.37	17,219,728.03
	Std Dev	296,463.77	513,629.57	23,430,276.55	7,901,408.94	19,257,619.96
2003	Mean	371,600.14	714,996.58	31,451,876.91	7,798,487.54	19,601,090.69
	Std Dev	299,701.61	506,382.22	27,487,253.91	9,451,716.82	22,593,351.57
2004	Mean	447,042.97	843,235.19	34,470,981.02	10,480,346.35	22,870,910.91
	Std Dev	331,316.61	646,053.25	34,924,927.73	13,508,478.43	26,232,232.41
2005	Mean	539,153.09	982,794.76	40,793,955.32	12,729,632.11	25,046,042.58
	Std Dev	385,272.22	707,020.24	34,526,091.81	11,798,711.27	25,676,160.68
2006	Mean	642,060.31	1,063,231.30	50,468,364.92	14,790,791.98	38,825,898.49
	Std Dev	543,086.40	842,497.93	45,396,064.90	16,010,980.84	47,526,849.47
2007	Mean	800,727.08	1,243,141.04	63,385,766.43	21,113,946.34	39,132,860.75
	Std Dev	672,659.82	993,182.86	52,827,076.47	22,501,201.86	35,969,580.81
2008	Mean	1,003,646.39	1,529,687.74	67,567,498.82	23,818,812.59	50,816,747.70
	Std Dev	850,969.75	1,560,498.78	64,781,431.80	23,832,911.56	40,161,230.80
2009	Mean	1,141,587.11	1,630,017.38	77,674,099.76	21,725,992.43	55,431,222.57
	Std Dev	957,878.35	1,641,508.86	62,792,708.45	21,655,723.46	40,281,794.25
2010	Mean	1,250,510.54	1,625,999.86	89,178,969.30	25,530,500.31	62,538,118.95
	Std Dev	1,100,402.80	1,555,144.52	78,059,014.15	25,765,633.80	46,560,261.12
2011	Mean	1,563,326.03	1,669,007.13	78,557,095.28	17,776,831.61	63,868,029.60
	Std Dev	1,343,171.26	1,436,820.19	68,844,784.61	15,607,394.45	52,598,316.47

On average from the 1998 to 2011, rate is 1 USD = 187 YR

Table 4.1 shows that the mean labor cost of banks has increased approximately more than seven-fold from RY 212,436.82 million in 1998 to RY 1,563,326.03 million in 2011 by a growth rate of 635 percent. This increase could be attributed to increase in normal wage as well as increase in salary for highly-skilled banking experts.

The banking sector in Yemen achieved a 692 percent growth in average deposits for the period from 1998 to 2011[2]. This may be due to the high interest rates on deposits which helped banks to attract more deposits. Growth rate of loans has increased 394 percent on average for the same period, but it is much lesser than growth rate of deposits for the same period. This reflects the fluctuations and instability of economic conditions in Yemen during the study period, and the reluctance of banks to provide fresh loans. It can be argued that the low growth rate of loans compared to deposits reflects the banks` concerns about business environment in Yemen, which is characterized as highly risky and uncertain. Consequently, they could be unwilling to be involved in loan markets heavily because business credits are very expensive to originate, keep, and monitor and thus more likely to default than investment securities.

During those years (1998-2011), Yemen banks focused extensively on improving their investment. As shown in Table 4.1, the amount of investment increased from RY 6,558,035.02 million in 1998 to RY 63,868,029.60 million in 2011, an increase of 873 percent. In addition, the average amount of capital also reflects the same high growth

[2] This finding contradicts Al-Suwaidi and Mahmood (2011) who claimed that Yemenis do not trust Yemeni bank.

path of 468 percent, with RY1, 669,007.13 million in 2011 compared to RY 293,465.87 million at the end of 1998.

Another important issue that should be taken into consideration is the correlation between inputs and outputs because of its great influence on the DEA model. Therefore, in order to establish proper and suitable inputs and outputs, a correlation analysis is considered necessary. As stated by Yang (2009), in a case where an input variable and one or more other input variables (or an output variable and one or more other output variables) are highly correlated, this variable (input or output) could be considered as a proxy for other variables. Thus, this variable (input or output) may not be included in the model. Conversely, in a case where an input variable and all the output variables (or an output variable and all the input variables) are lowly correlated, it could reflect the unfitness of this variable in the model (Yang, 2009). Table 4.2 presents the results of correlation analysis between the inputs and the outputs.

Table 4.2
Correlation of Input and Output Variables

	Labor	**Capital**	**Deposits**	**Investment**	**Loans**
Labor	1.00	0.67	0.68	0.63	0.57
Capital	0.67	1.00	0.57	0.55	0.74
Deposits	0.68	0.57	1.00	0.92	0.58
Investment	0.63	0.55	0.92	1.00	0.55
Loans	0.57	0.74	0.58	0.55	1.00

As shown in Table 4.2, this study does not record any evidence that any one of the input variable and others (or between any of the output variables) is highly correlated. Similarly, no evidence is found that any of the input variables and any of the output variables (or between output variable and input variables) is lowly correlated. Hence, all the inputs and outputs fit the model.

4.3 Estimation of Banks' Efficiency Score in Yemen

The inputs and outputs are used in DEA to obtain the efficiency score for each technical, pure technical and scale efficiency. This efficiency score shows the association between the activities of banks. The results of technical efficiency (TE) and its components, pure technical efficiency (PTE), and scale efficiency (SE) for Yemen banks are presented in Table 4.3.

Table 4.3
Efficiency Measure of the Yemen Banking Sector (1998 - 2011)

Years	**No of Banks**	**No of Efficient Banks**	**Minimum**	**Std. Dev.**	**Average Efficiency (E)**	**Average Inefficiency [(1-E)/E][3]**
Technical Efficiency						
1998	10	4	0.588	0.186	0.792	0.262
1999	11	4	0.526	0.171	0.815	0.227
2000	11	3	0.455	0.183	0.767	0.304
2001	11	3	0.227	0.255	0.719	0.390
2002	12	3	0.571	0.143	0.844	0.185
2003	12	2	0.233	0.226	0.674	0.484
2004	13	5	0.318	0.270	0.734	0.363
2005	13	5	0.454	0.235	0.768	0.302
2006	14	4	0.348	0.277	0.667	0.499
2007	14	4	0.346	0.277	0.701	0.427
2008	14	7	0.291	0.283	0.773	0.293
2009	14	4	0.356	0.244	0.768	0.303
2010	14	4	0.342	0.276	0.761	0.314
2011	14	3	0.311	0.251	0.641	0.560
Averages			0.383	0.234	0.745	0.351
Pure Technical Efficiency						
1998	10	8	0.679	0.106	0.954	0.048
1999	11	6	0.620	0.139	0.918	0.089
2000	11	7	0.566	0.159	0.901	0.110
2001	11	5	0.324	0.247	0.796	0.256
2002	12	6	0.588	0.140	0.883	0.133
2003	12	4	0.461	0.186	0.829	0.206
2004	13	5	0.318	0.231	0.778	0.285
2005	13	6	0.601	0.149	0.879	0.137
2006	14	4	0.381	0.252	0.745	0.342
2007	14	7	0.481	0.195	0.837	0.194
2008	14	7	0.462	0.191	0.858	0.165
2009	14	8	0.586	0.154	0.898	0.114
2010	14	10	0.612	0.116	0.947	0.056
2011	14	8	0.514	0.183	0.858	0.165
Averages			0.514	0.175	0.863	0.164

[3] Following Isik and Hassan (2002), the relationship between efficiency (E) and inefficiency (IE) is IE = (1- E)/E. Thus, the 74.5% efficiency implies 35.1% inefficiency, not 25.5% (or not 1-0.745).

Table 4.3 (Continued)

Years	No of Banks	No of Efficient Banks	Minimum	Std. Dev.	Average Efficiency (E)	Average Inefficiency [(1-E)/E]
Scale Efficiency						
1998	10	4	0.588	0.165	0.831	0.203
1999	11	4	0.605	0.123	0.888	0.126
2000	11	3	0.666	0.111	0.848	0.179
2001	11	3	0.700	0.106	0.892	0.121
2002	12	3	0.850	0.054	0.956	0.046
2003	12	2	0.416	0.160	0.799	0.252
2004	13	5	0.541	0.134	0.931	0.074
2005	13	5	0.522	0.177	0.864	0.157
2006	14	4	0.550	0.136	0.886	0.128
2007	14	4	0.471	0.186	0.817	0.223
2008	14	7	0.492	0.176	0.873	0.145
2009	14	4	0.469	0.203	0.849	0.178
2010	14	4	0.358	0.256	0.798	0.253
2011	14	3	0.419	0.216	0.740	0.351
Averages			0.546	0.157	0.855	0.174

Table 4.3 displays the efficiency measures of all banks over the period 1998-2011, along with other descriptive statistics, i.e., minimum and standard deviation of technical, pure technical and scale efficiencies, while Figure 4.1 graphs the summaries drawn from Table 4.3. As shown above, the average score for technical efficiency, pure technical efficiency and scale efficiency for all banks over the sample period is 74.5 percent, 86.3 percent and 85.5 percent, respectively.

These results imply that the average efficient bank could only reach 74.5 percent of technical efficiency it is expected to generate. Thus, there is a slack of 35.1 percent, meaning that the average efficient bank lost an opportunity to receive 35.1 percent more

revenue, given the same amount of resources. Clearly, the highest level of inefficiency is on the technical efficiency, followed by the scale efficiency.

Furthermore, for pure technical efficiency, the results imply that Yemeni banks on average have employed 86.3 percent of their resources to generate the same quantity of output. This implies that about 16.4 percent of the inputs have been wasted. It can also imply that 16.4 percent of its inputs have been saved to generate equal amount of outputs. Thus, there is a large opportunity for cost savings if the banks employ their inputs more efficiently. Similarly, the average bank has used 85.5 percent of its scale efficiency, and lost the opportunity to use 17.4 percent of its scale efficiency. In conclusion, the split of the overall technical inefficiency or efficiency into its constituent indicates that the primary source of inefficiency in Yemeni banking is scale inefficiency. This result of the dominant effect of scale efficiency over pure efficiency is consistent with the conclusions reached by Moffat (2008) for Botswana banking, Sufian and Abdul Majid (2007) for Singapore banking, Maghyereh (2004) for Jordanian banking and Isik and Hassan (2002) for Turkish banking.

Interpreting these results is to suggest that these banks have not been using the resources efficiently to produce the outputs. Hence, the same outputs could have been produced by fewer inputs. The value of technical efficiency is almost similar to that reported in developing countries. For example, Jreisat and Paul (2011) and Bahattchary, *et al*. (1997) estimated technical efficiency of Jordan and India at about 75 percent and 80 percent, respectively.

As shown in Table 4.3, banks in Yemen have shown fluctuations in technical efficiency and its components over the study period. There are several reasons for these fluctuations. A plausible explanation for this finding is that the competition among Yemeni banks is weak and competitive pressures in Yemeni banking sector might not be strong enough to force banks to sustain their efficiency for survival. Another possible explanation for this finding is that the low, but continuous economic growth of Yemeni economy in recent years appears to have incited the demand for banking services and products as indicated by the average growth rate of Yemen banks' assets (18 percent) during the study period. As a result of increasing economic growth, the banks may have found themselves forced to expand their scales in order to satisfy the increasing demand for banking products and services. Nonetheless, the problem associated with bank's operation is heightened as they grow larger in a very short period. In general, when the bank grows very fast, the managers may have insufficient time and expertise to deal with all details of operations. Also, banks that stress growth do so by trading-off credit quality. Allowances, non-performing loans, and ultimately loan losses go up such that net margins fall. Therefore, many banks in Yemen could simply grow more than their obtainable management skills. As a result, bank efficiency suffers (Isik & Hassan, 2002).

In addition, in recent years (i.e., 2010 and 2011), Yemeni banks tend to raise deposits and interest rates because public competes highly for funds and stresses on short-term deposits due to high inflation rates, which was 16 percent in 2011 compared to 11 percent in 2010. Such policies might result in tremendous bank sizes and ultimately

engulf overhead costs that might adversely affect banking efficiency. Figure 4.1 depicts technical, pure technical and scale efficiencies scores in each year.

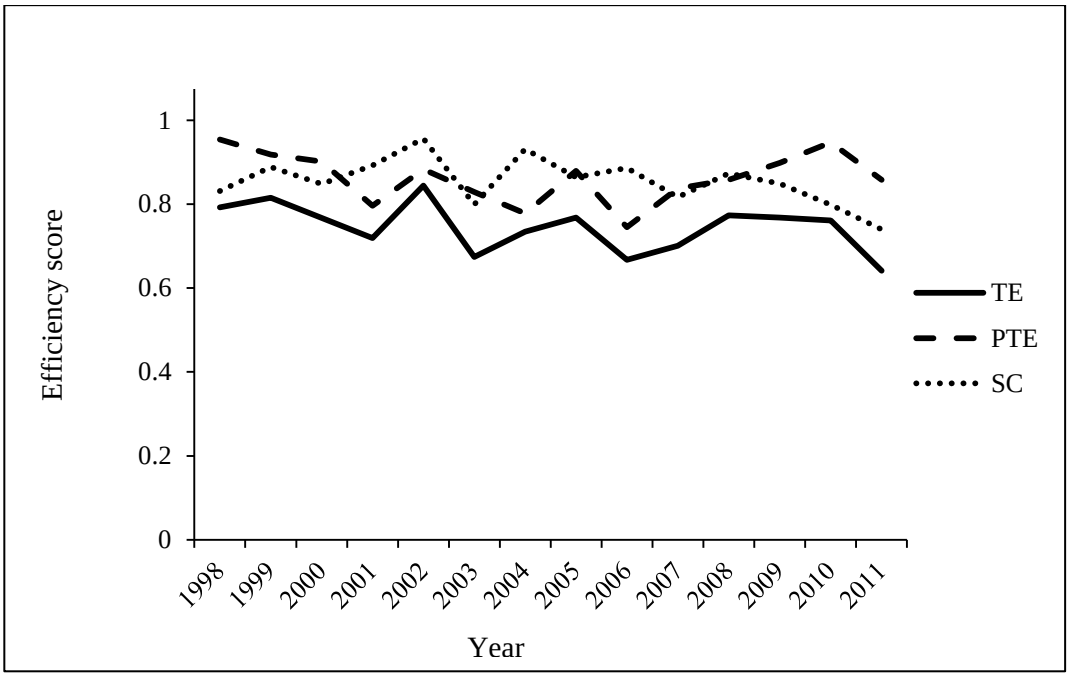

Figure 4.1
Technical, Pure and Scale Efficiency of Yemeni Banks, 1998-2011

The issue of scale inefficiency is looked at in detail by reflecting on the indicators of returns-to-scale (RTS). As shown in Table 4.4, most Yemeni banks operate at 'incorrect' scale since the CRS is only 32 percent. The banks are experiencing economies of scale (or increasing return to scale [IRS]) because of their size below the optimum level. Also, they could be experiencing diseconomies of scale (or decreasing returns to scale [DRS]) because of their size above the optimum level. The inefficiency scale resulting from IRS

could be attributed to new and small banks that are desirably striving to grow up to the 'right' scale but unable to do so presently. On the other hand, the inefficiency scale resulting from DRS could be attributed to large banks that have gone beyond the 'right' scale to catch up with the excess market demand for financial services and products brought about by the growing Yemen economy. The results suggest that on average, among 14 banks, 32 percent operate under (CRS), and 13 percent operate under (IRS). Thus, the policy implication of this finding is that these banks can enhance efficiency by increasing their size. The remaining 55 percent of banks operate under (DRS). Therefore, downsizing appears to be the right strategic option to lessen unit costs, and consequently, increase efficiency by these banks.

Table 4.4
Number and Percentage of Nature of Return to Scale in Yemen's Bank Sector

RTS	**CRS**		**DRS**		**IRS**	
Years	**No of Banks**	**% share**	**No of Banks**	**% share**	**No of Banks**	**% share**
1998	4	40	4	40	2	20
1999	4	36	6	55	1	9
2000	3	27	6	55	2	18
2001	3	27	6	55	2	18
2002	3	25	7	58	2	16
2003	2	17	7	58	3	25
2004	5	38	5	38	3	24
2005	5	38	7	54	1	8
2006	4	29	7	50	3	21
2007	4	29	9	64	1	7
2008	7	50	7	50	0	0
2009	4	29	9	64	1	7
2010	5	36	8	57	1	7
2011	3	21	10	72	1	7
Averages		32		55		13

Notes; (CRS), Constant return to scale; (DRS), Decrease return to scale; (IRS), Increase return to scale.

4.3.1 DEA Estimates of Efficiency for Government, Foreign and Domestic Banks

In order to obtain more insights about efficiency of banks in Yemen, this study classified banks based on their ownership status, i.e., government banks, foreign banks and local banks. Table 4.5 provides estimates on the efficiency for these banks for the period from 1998 to 2011.

Table 4.5
DEA Estimates of Efficiency for Government, Foreign and Local *Banks, 1998-2011*

Bank Classification	Descriptive Statistics	Technical Efficiency	Pure Technical Efficiency	Scale Efficiency
Government banks	Mean	0.527	0.750	0.778
	Std. Dev	0.142	0.168	0.135
	Minimum	0.227	0.318	0.361
	Maximum	1.000	1.000	1.000
Foreign banks	Mean	0.880	0.994	0.883
	Std. Dev	0.169	0.013	0.163
	Minimum	0.346	0.702	0.358
	Maximum	1.000	1.000	1.000
Local banks	Mean	0.766	0.842	0.902
	Std. Dev	0.206	0.179	0.096
	Minimum	0.233	0.440	0.416
	Maximum	1.000	1.000	1.000

As shown in Table 4.5, there are vast differences among government, local, and foreign banks in terms of technical efficiency and its two components over the sample period. In each group, banks have shown fluctuations in technical efficiency and its components over the study period. Foreign banks have shown the highest average technical efficiency scores (88 percent) followed by local banks (76.6 percent) and government banks which achieved the lowest average technical efficiency scores (52.7 percent). The high level of efficiency for foreign banks is consistent with the results found by other studies, such as Isik and Hassan (2002) and Shanmugan and Das (2004), which were conducted in developing countries. The high efficiency for foreign banks may be

attributable to high management expertise as well as their exposure to competitive practices world-wide, as majority of the foreign banks are multinationals. In comparing with their foreign counterparts, Yemeni banks lack such wide managerial experience and modern banking practices due to their limited international presence and weak connection with the global financial system.

However, by looking at the foreign banks' contribution to the economic growth of Yemen, this study finds that foreign banks report the lowest average percentage of loans to total assets which is only 11 percent in the sample period. This implies that foreign banks do not significantly contribute to the economic growth of Yemen since they lend to certain types of customers and most of their assets are invested with their headquarters.

Government banks record an average 52.7 percent, 75 percent and 77.8 percent for technical, pure technical and scale efficiencies, respectively, which suggests that the primary source of inefficiency is the pure efficiency. The average score reported by the local banks is relatively high with 76.6 percent, 84.2 percent and 90.2 percent for technical, pure technical and scale efficiencies, respectively. Similar to government banks, the results also suggest that the primary source of inefficiency in local banks is pure efficiency. The results also show that in terms of overall technical efficiency there is an efficiency gap between Yemeni government banks and local banks since local banks clearly outweigh government banks. Figures 4.2, 4.3 and 4.4 display technical, pure and scale efficiency scores of government, foreign and local banks in each year respectively.

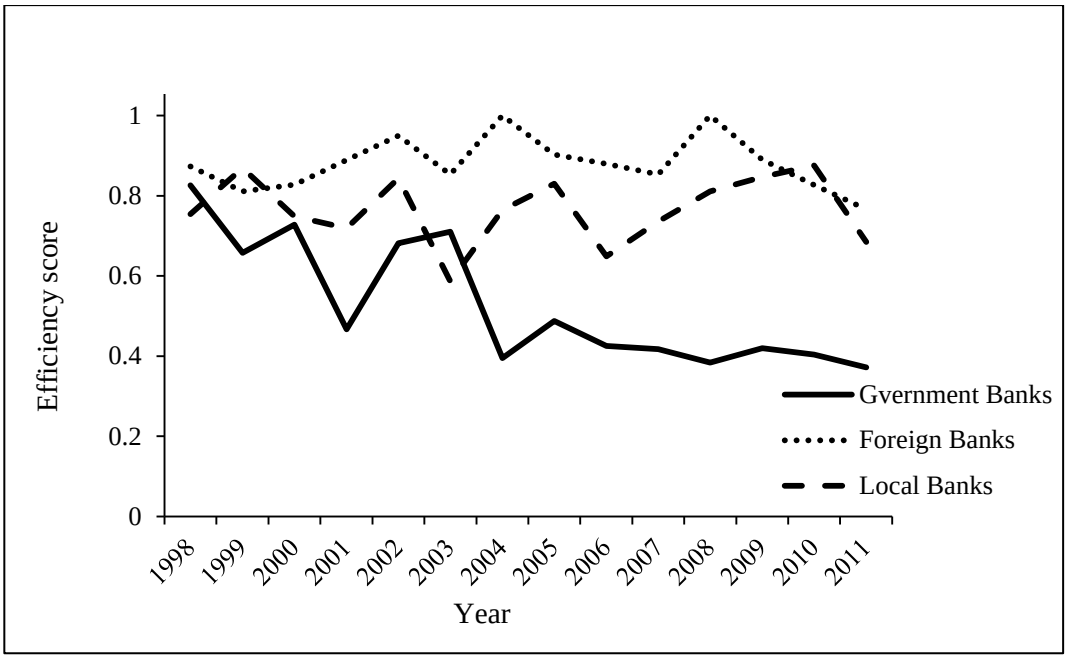

Figure 4.2
Technical Efficiency of Government, Foreign and Local

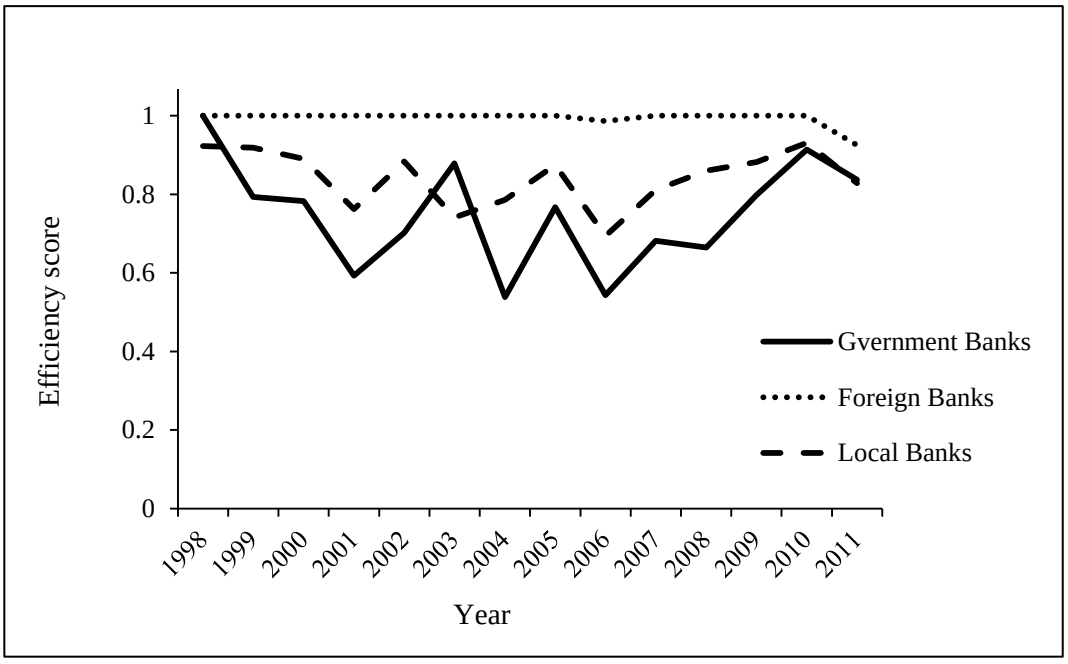

Figure 4.3
Pure Technical Efficiency of Government, Foreign and Local

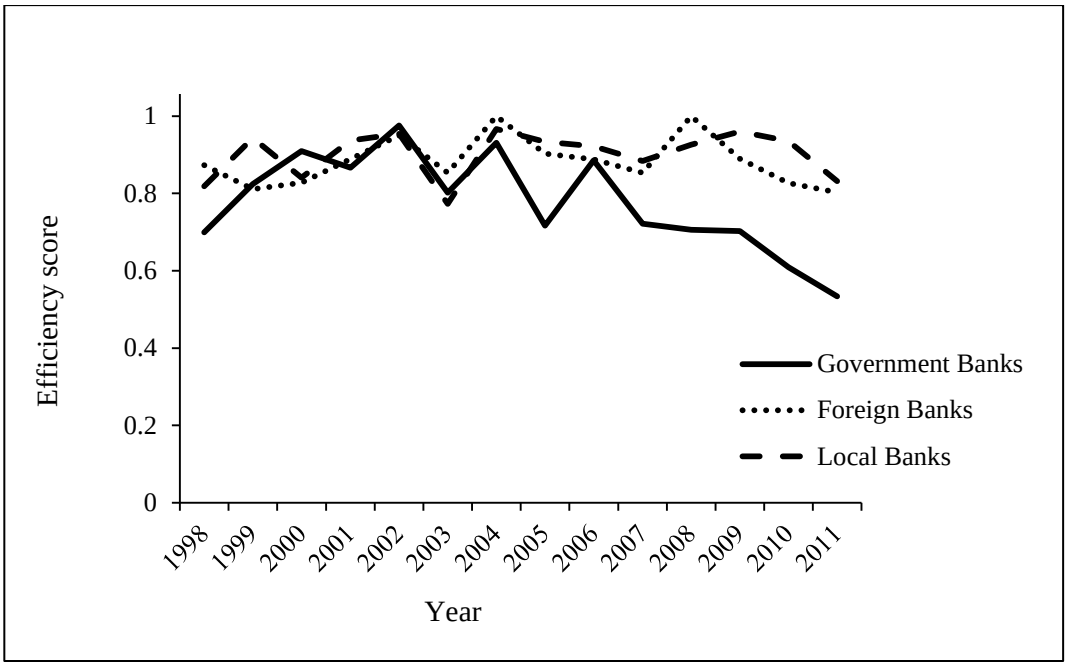

Figure 4.4
Scale Efficiency of Government, Foreign and Local

Nonetheless, this result is expected considering the Yemen situation due to the following reasons. In the first instance, government banks are always believed to have multiple goals as pointed out by Das and Ghosh (2006). The process of liberalization might have caused an obvious attention on profit maximization and definite peripheral objectives, such as encouragement to employ low skilled workers. Unfortunately, in Yemen, employment practices in government firms, or in firms where government ownership is dominant, such as banks, are more likely to be subject to political or tribal concerns which may affect bank efficiency negatively. Secondly, it appears Yemeni bank managers could have pursued a strategy to offer a greater and sudden increase in loans by paying high priority to a specific sector in an attempt to implement government policy. Loans are then advanced at rates below market rates which might eventually

yield a low return. For instance, one of the government banks, "Cooperative & Agricultural Credit Bank", finances unpredictable agricultural projects which are liable to weather conditions and have high tendency to default risks.

Further analysis is done by conducting statistical test to find out whether there are differences in the average efficiency scores between government, foreign and local banks. The Kruskal-Wallis one-way analysis of variance by ranks is used to test whether samples originate from the same distribution. It is used for comparing more than two samples that are independent, or not related. The summary of estimated results is provided in Table 4.6.

Table 4.6
Kruskal-Wallis Test for Difference in Variances for Efficiency Components from DEA

	Technical Efficiency	**Pure Technical Efficiency**	**Scale Efficiency**
Chi-Square	27.712	27.256	9.126
df	2	2	2
Asymp. Sig.	0.000***	0.000***	0.010*

Notes: * significant at 10% level, ** significant at 5% level, *** significant at 1% level

Based on Table 4.6, it can be concluded that the Kruskal-Wallis Test rejects the null hypothesis which states that there is no difference among government, foreign and local banks in terms of technical, pure technical and scale efficiencies.

To point out the differences in mean of technical efficiency scores and its components among the three groups of banks in Yemen, the Mann-Whitney test is conducted for two-sample. The estimated results of the Mann-Whitney test are provided in Table 4.7.

Table 4.7
Mann-Whitney Test for Two Independent Samples for Technical, Pure Technical, and Scale Efficiency, based on DEA Estimation

Bank Type	**Technical Efficiency**	**Pure Technical Efficiency**	**Scale Efficiency**
Government banks Vs. Foreign banks	-4.412***	-4.358***	-2.252**
Government banks Vs. Local banks	-3.583***	-2.022**	-2.757***
Local banks Vs. Foreign banks	-3.287***	-4.642***	-0.965

Notes: * significant at 10% level, ** significant at 5% level, *** significant at 1% level

The results in Table 4.7 show that significant differences exist between government and foreign banks operating in Yemen, as well as between government and local banks in terms of technical efficiency and its components at one percent and five percent significance levels. The Table also shows that there are significant differences between local and foreign banks operating in Yemen in terms of technical efficiency and pure technical efficiency at one percent significance level, but there is insignificant difference between local and foreign banks in terms of scale efficiency.

4.3.2 Efficiency of Yemen Banks Based on Bank Type

Besides ownership, the banks are also classified according to the type of bank i.e., commercial and Islamic banks. It is depicted in Table 4.8 that Islamic banks outperform their counterparts in all efficiency scores (i.e., technical, pure technical, and scale efficiencies). This result is consistent with findings of previous studies, such as Alsarhan (2009), Hussein (2004) and Al-Jarrah and Molyneux (2003). This finding implies that Islamic banks as compared to conventional banks are more efficient.

Table 4.8
Efficiency of Yemen Banks Based on Bank Type

Bank Classification	Descriptive Statistics	Technical Efficiency	Pure Technical Efficiency	Scale Efficiency
Commercial Banks	Mean	0.707	0.844	0.833
	St.Dev	0.234	0.183	0.161
	Minimum	0.227	0.318	0.358
	Maximum	1.000	1.000	1.000
Islamic Banks	Mean	0.838	0.910	0.912
	St.Dev	0.171	0.126	0.097
	Minimum	0.233	0.453	0.416
	Maximum	1.000	1.000	1.000

This finding could be attributed to the fact that Islamic banking relies on profit-sharing contracts, which involve an equity participation principle with depositors, and banks can therefore be seen as intermediating savers and investors by transforming deposits into earning assets, rather than as producers of services and loans. In addition, Pock (2007)

states that bank reputation as an Islamic Shariah-compliant bank is expected to have an impact on its performance. This study argues that operating under Islamic Shariah principles and consistent with religious beliefs of employees will create positive perceptions among employees and make them more satisfied. Efficiency of banks could subsequently be improved because of the positive association between employees' satisfaction and bank efficiency. Figures 4.5, 4.6 and 4.6 illustrate technical, pure technical and scale efficiency score of commercial banks and Islamic banks.

In order to identify the differences in average technical, pure technical and scale efficiencies scores between commercial banks and Islamic banks of Yemeni banks, a Mann-Whitney test is conducted for two-sample with the assumption of unequal variances. The results obtained from the Mann-Whitney estimation are reported in Table 4.9.

Table 4.9
Mann-Whitney U Test between Commercial Banks and Islamic Banks

	Technical Efficiency	**Pure Technical Efficiency**	**Scale Efficiency**
Z	-3.124***	-2.205**	-2.849***
Asmp. Sig	0.002	0.027	0.004

Notes: *** significant at 1% and ** significant at 5% level.

Results in Table 4.9 indicate that significant differences exists between commercial banks and Islamic banks operating in Yemen in terms of technical, pure technical and scale efficiency, at one percent significance level for technical and scale efficiency and at five percent significance level.

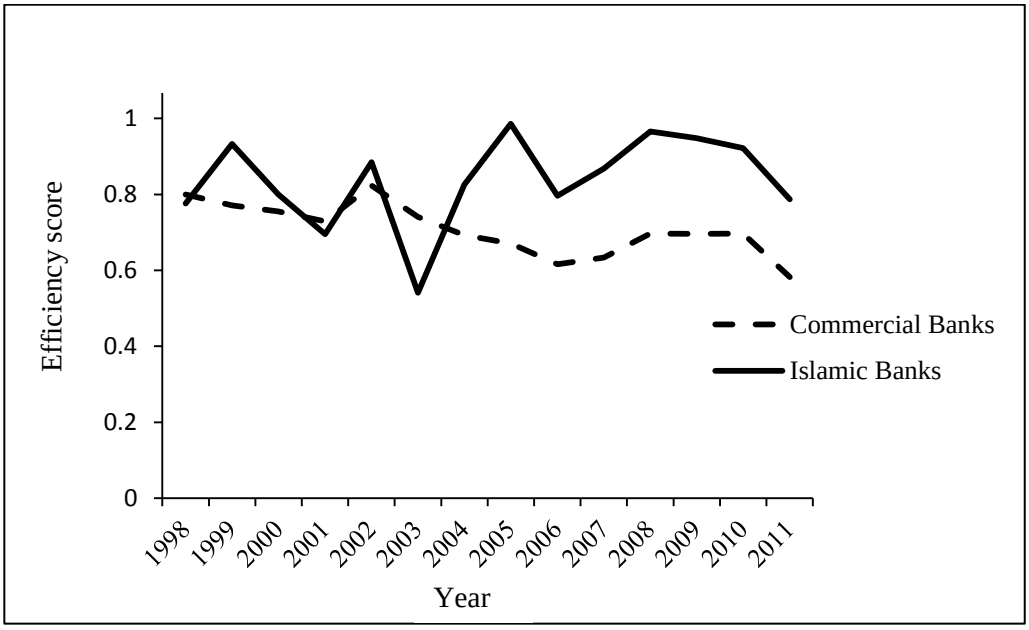

Figure 4.5
Technical Efficiency of Commercial and Islamic Banks

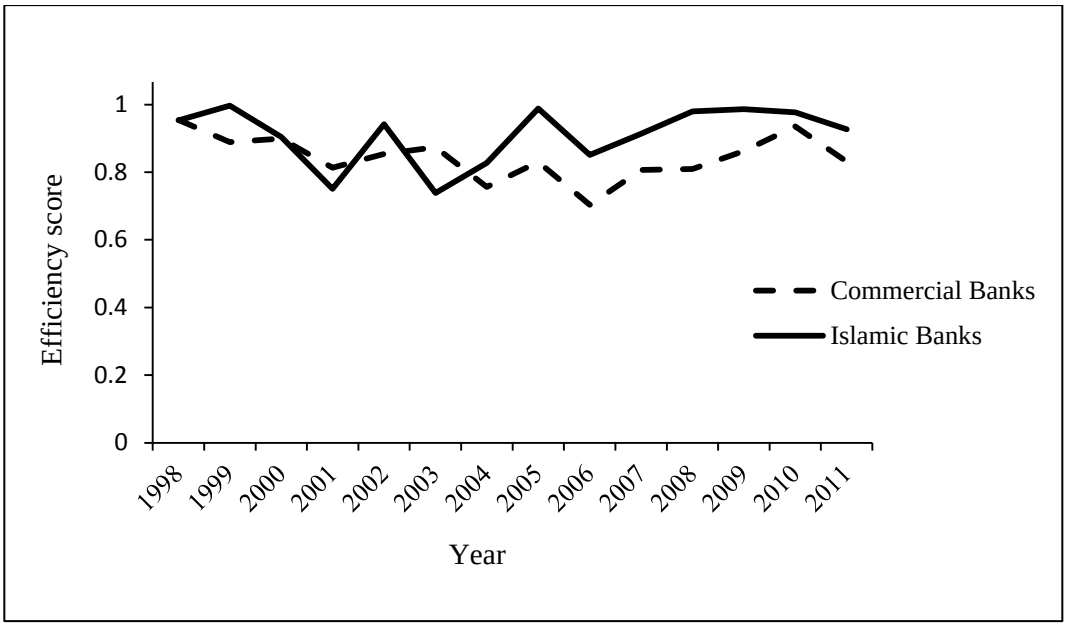

Figure 4.6
Pure Technical Efficiency of Commercial and Islamic Banks

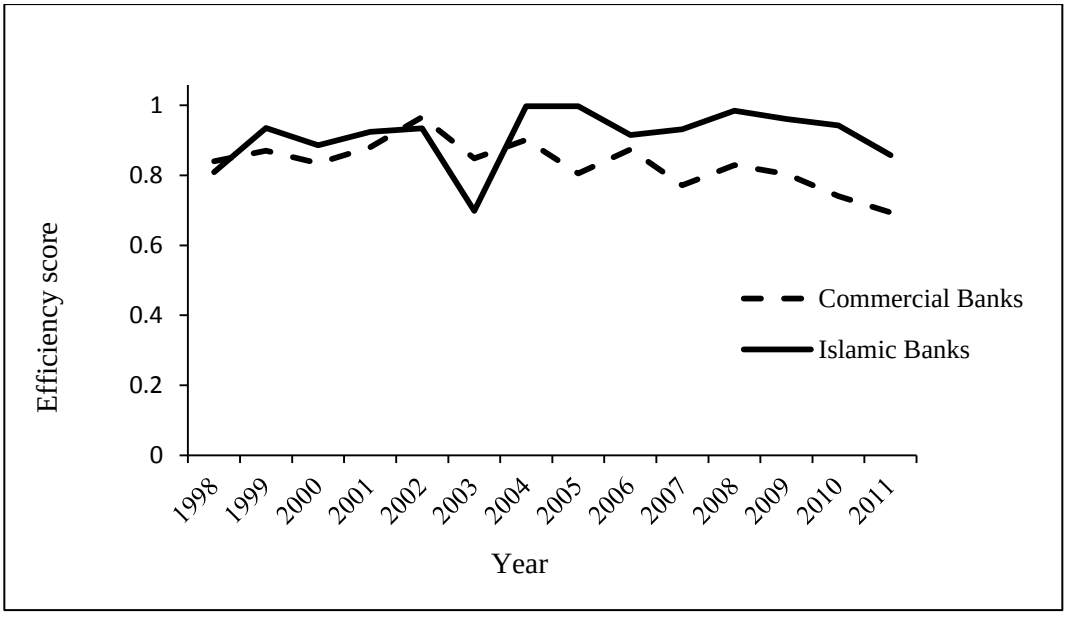

Figure 4.7
Scale Efficiency of Commercial and Islamic Banks

4.3.3 Efficiency of Yemen Banks Based on Bank Internationalization

The banks are also classified according to their international operations. Banks are considered as international banks if it has subsidiaries abroad. Table 4.10 provides estimates on the efficiency for these banks for the period from 1998 to 2011. Data from Table 4.10 are shown graphically in Figures 4.8, 4.9 and 4.10. International banks have shown higher efficiency scores (technical, pure technical, and scale) than their local peers. These finding are in line with some studies from developing countries that find international banks are more efficient than local banks, such as Isik and Hassan (2002) in Turkey and Mahajan *et al*. (1996) in USA.

Table 4.10
Efficiency Measures of Yemen Banks Classified by Banks' Internationalization

Bank Classification	**Descriptive Statistics**	**Technical Efficiency**	**Pure Technical Efficiency**	**Scale Efficiency**
International Banks	Mean	0.881	0.932	0.942
	St.Dev	0.147	0.096	0.061
	Minimum	0.345	0.453	0.687
	Maximum	1.000	1.000	1.000
Local Banks	Mean	0.687	0.811	0.838
	St.Dev	0.236	0.180	0.159
	Minimum	0.227	0.318	0.361
	Maximum	1.000	1.000	1.000

The higher level of efficiency shown by international banks may be attributed to several factors. First, operating in international markets could enhance the efficiency due to the exploitation of scope or scale economies and second, the banks could learn new techniques and concepts from abroad. Moreover, local banks are relatively small and usually are not exposed to the problems stemming from an increase in scale. Local banks` problems seem to be more related the under-utilization of resources rather than to operating at an incorrect scale.

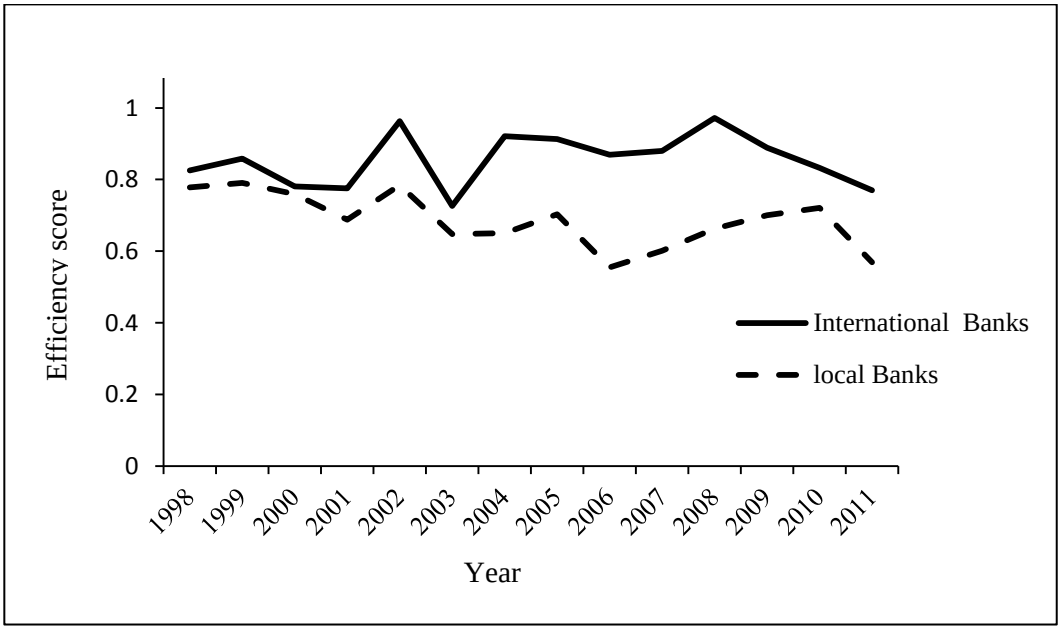

Figure 4.8
Technical Efficiency by Bank Internationalization

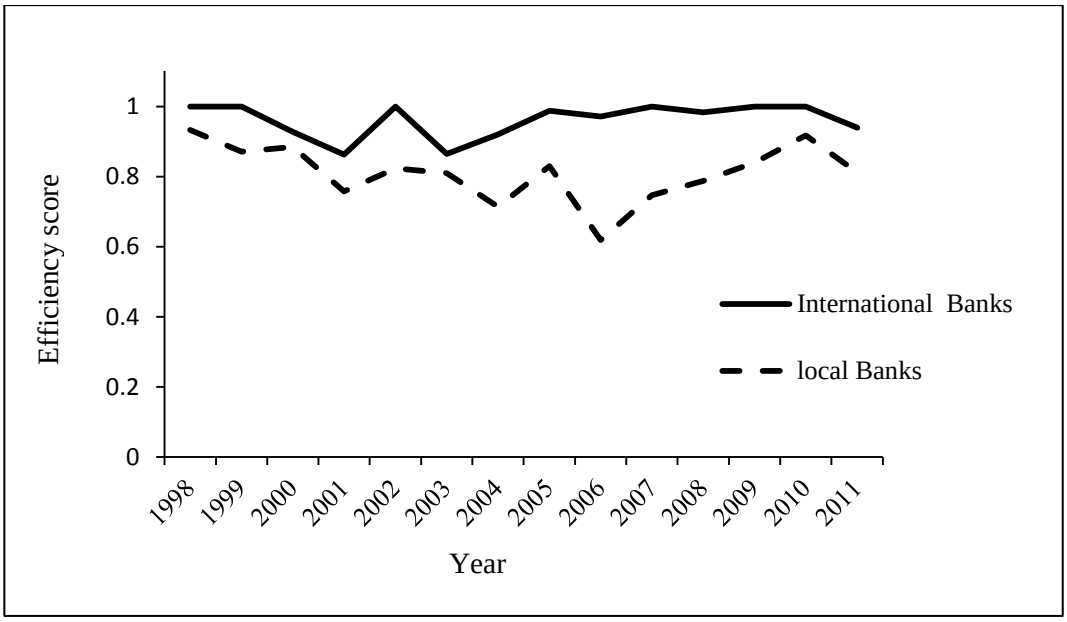

Figure 4.9
Pure Technical Efficiency by Bank Internationalization

Figure 4.10
Scale Efficiency by Bank Internationalization

To point out the differences in mean of technical efficiency scores and its components among the international and local banks in Yemen, the Mann-Whitney test is conducted for the two-samples. The estimated results of the Mann-Whitney test are provided in Table 4.11.

Table 4.11
Mann-Whitney U Test between International Banks and Local Banks

	Technical Efficiency	**Pure Technical Efficiency**	**Scale Efficiency**
Z	-3.722***	-3.047***	-3.263***
Asmp. Sig	0.000	0.002	0.001

Notes: *** significant at 1%.

It can be drawn from results in Table 4.11 that there are significant differences between international banks and local banks in terms of technical, pure technical and scale efficiencies at one percent significance levels.

4.4 Descriptive Statistics of Independent Variables

Table 4.12 reports the descriptive statistics for dummy independent variables selected in this study. As depicted in Table 4.12, four banks out of 14 banks are Islamic banks and two banks out of 14 banks have subsidiaries in international markets. There are four foreign banks out of 14 banks operating in Yemen constituting 29 percent of total number of banks operating in Yemen. There are 7 local private banks out of 14 banks operating in Yemen constituting 50 percent of total number of banks operating in Yemen.

Table 4.12
The Descriptive Statistics for Dummy Independent Variables

Variables	**TYPE**		**INTSU**		**FOR Banks**		**LPR Banks**	
	Islamic	**Conventional**	**Yes**	**Rest**	**Yes**	**Rest**	**Yes**	**Rest**
n	4	10	2	12	4	10	7	7
(%)	29%	71%	14%	86%	29%	71%	50%	50%

Notes: (INTSU), Internationalization of banks; (TYPE), Type of banks; (FOR Banks), Foreign banks; (LPR Banks), Local private banks.

It is important to mention here that the financial crisis periods (2008 and 2009) are considered in this study. Table 4.13 reports the descriptive statistics for continuous independent variables selected in this study. With regards to bank specific characteristics, Table 4.13 shows that size of bank, capitalization and non-performing loans have means (minimum) of 10.60 (9.55), 11 percent (0.01) and 20 percent (0.01), respectively. The reported average value of profitability indicates that the return gained by banks in Yemen is low on average equity (ROE) that has a mean (minimum) of 13

percent (-0.18). Further, ATMs have a mean (minimum) of 0.53 (0.00). This figure is lower than that reported in MENA. The intellectual capital performance for the sample banks throughout the study period varies from -3.13 (minimum) to 16.27 (maximum) and the mean for the intellectual capital performance is 3.97 percent. This figure is lower than that reported by Al-Musali and Ku Ismail (2012) for GCC banks (4.20 percent), Al-Musali and Ku Ismail (2011) for United Arab Emirates banks (UAE) (4.34 percent), El-Bannany (2008) for UK banks (10.3 percent) and Goh (2005) for Malaysian banks (7.11 percent). Turning to macroeconomics variable, the real gross domestic product (GDP), reported a mean (minimum) of 3.31 (-10.48).

Table 4.13
Descriptive Statistics of the Continuous Independent Variables

Variables	Mean	St. Dev	Median	Maximum	Minimum
BSIZE	10.60	0.48	10.60	11.58	9.55
ROE	0.13	0.11	0.13	0.59	-0.18
NPL	0.20	0.21	0.14	0.96	0.01
FINCP	0.11	0.09	0.08	0.57	0.01
ATMs	0.53	0.70	0.00	2.13	0.00
ICP	3.97	3.31	3.35	16.27	-3.13
GDP	3.31	4.26	3.8	7.7	-10.48

(BSIZE) Bank size; (ROE), Profitability; (FINCP), Financial capital; (NPL), Non-performing loans; (INTSU), Internationalization of banks; (ATMs), Automated Teller Machines; (TYPE), Type of banks; (ICP), Intellectual capital performance; (GDP), Gross domestic product.

To get more insights, VAIC is spilt into its three components, i.e., human capital efficiency (HCE), structural capital efficiency (SCE) and capital employed efficiency (CEE). As shown in Table 4.14 and based on the fourteen years' consecutive annual reports, this study could assess the change in value creation efficiency level (i.e., intellectual capital performance and its components) over time. The human capital efficiency (HCE) and VAIC fluctuated over the period of study (from 1998 to 2011), indicating instability of intellectual capital performance level. Banks in Yemen have shown fluctuations in intellectual capital performance level from structural capital (SCE), but intellectual capital performance level from capital employed (CEE) remained relatively constant.

Table 4.14
Descriptive VAIC and its Components (HCE, SCE and CEE)

Variables	**HCE Average**	**SCE Average**	**CEE Average**	**VAIC Average**
1998	4.55	0.46	0.04	5.05
1999	3.37	0.37	0.03	3.76
2000	2.16	0.36	0.02	2.55
2001	4.23	0.53	0.03	4.78
2002	1.49	0.64	0.02	2.15
2003	2.57	0.53	0.02	3.12
2004	3.30	0.69	0.02	4.01
2005	3.71	0.59	0.03	4.33
2006	4.07	0.62	0.03	4.73
2007	3.87	0.67	0.03	4.57
2008	3.35	0.60	0.02	3.98
2009	3.17	0.56	0.03	3.76
2010	3.64	0.42	0.03	4.10
2011	4.01	0.43	0.04	4.48

Note: (HCE), human capital efficiency; (SCE), structural capital efficiency; (CEE), capital employed efficiency.

A comparison of VAIC components suggests that during 1998-2011, the banks in Yemen are generally more effective in generating value from its human capital rather than from its physical and structural assets. The results show that the major contribution to the IC is mainly from human capital compared to structural and physical capitals. However, Table 4.14 shows that there is no constant progress in creating value from human resources since HCE values fluctuate over the study period. Figure 4.9 depicts estimated mean from VAIC scores and its components in each year.

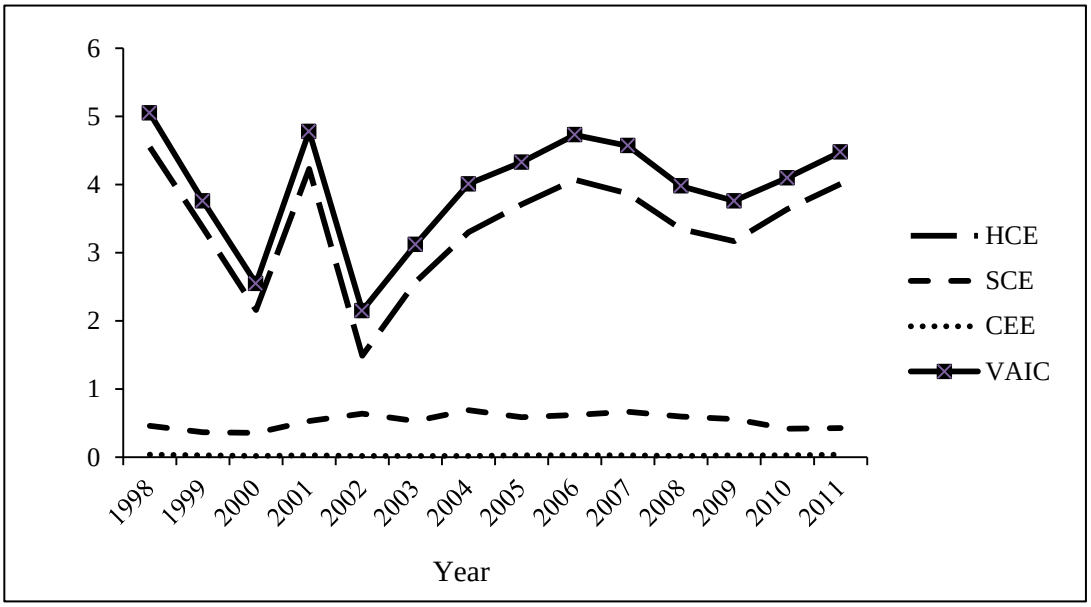

Figure 4.11
VAIC and its Components

4.5 Assumptions of Tobit Regression Analysis

The hypotheses in this study are tested by using Tobit (or censored) regression analysis. The Tobit Model was proposed by James Tobin in 1958. It estimates a linear regression model for a left-censored dependent variable. To avoid misleading results, regression diagnostic tests must be done to verify the data's compatibility for the Tobit regression analysis, before the model is accepted. Several procedures are undertaken to assess the compatibility of the data with the following assumptions of the Tobit regression.

4.5.1 Normality

Normality, being the fundamental assumption in data analysis, refers to the shape of the data distribution for an individual metric variable and its correspondence to the normal distribution. Normality for each variable may be checked in a number of ways such as using a histogram with normality plot and the Kolmogorov-Smirnov, skewness and kurtosis value.

This study uses the Kolmogorov-Smirnov test which is a chi-square based test to determine whether the cumulative distribution of the residuals is significantly different from the theoretical normal distribution. The null hypothesis is that there is no statistically significant difference. When the probability is less than 0.05, the null hypothesis must be rejected and the inference would be that the residuals are non-normally distributed. For this study the probability is 0.2702. Therefore, the null hypothesis is accepted and therefore the inference is that the residuals are normally distributed.

4.5.2 Multicollinearity

Multicollinearity is the intercorrelation of the independent variables. The main worry is that when there is rise in the level of multicollinearity, the estimated coefficients of the regression model tends to be unstable and the coefficients of the standard errors tend to get large. High multicollinearity causes the estimated regression coefficient to become unreliable and unstable, so that it might change drastically if small changes occur in the sample or model (Hamilton, 2004). The Pearson correlation test is conducted to explore the correlations between the independent variables and to indicate the existence of multicollinearity. The Pearson correlation coefficients among the independent variables are presented in Table 4.15. The Table shows that the correlation coefficients are less than 0.7. According to Hair, Black, Babin, Anderson, and Tatham (2006) and Gujarati (2003), the correlation between the independent variables is not a concern until it exceeds 0.7. Thus, this suggests that multicollinearity is not a problem in the regression.

Table 4.15

Pearson Correlation between Independent Variables

	BSIZE	Crisis	FINCP	GDP	ICP	INTSU	ATMs	NPL	ROE	TYPE	FOR Banks	LPR Banks
BSIZE	1.000											
Crisis	0.431	1.000										
FINCP	-0.340	0.300	1.000									
GDP	-0.185	-0.340	-0.150	1.000								
ICP	-0.073	0.022	0.325	-0.045	1.000							
INTSU	0.343	0.162	-0.041	--0.098	-0.134	1.000						
ATMs	0.595	0.216	-0.144	-0.227	-0.117	0.359	1.000					
NPL	-0.269	-0.018	0.326	-0.073	0.255	-0.145	-0.197	1.000				
ROE	0.304	-0.174	-0.316	0.074	0.304	-0.132	-0.007	0.018	1.000			
TYPE	-0.083	-0.012	0.074	0.004	-0.152	0.057	0.125	-0.250	-0.215	1.000		
FOR Banks	-0.048	0.019	0.124	-0.016	0.498	-0.147	-0.293	0.175	0.101	-0.387	1.000	
LPR Banks	0.155	-0.027	0.0152	0.019	-0.359	0.229	0.276	-0.345	0.606	0.325	-0.639	1.000

Another way to check for multicollinearity is to look at the collinearity tolerance and the variance inflation factor (VIF) for all the variables in the regression model. Hair, Anderson, Tatham and Black (2010) suggest that if an independent variable has a collinearity tolerance more than 0.1 and VIF less than 10, a multicollinearity problem does not exist. Accordingly, the results in Table 4.16 indicate all of the collinearity tolerance values are found to be above the value of 0.1, and all of the VIF values are found to be below the value of 10. Therefore, multicollinearity is unlikely to affect the regression analysis.

Table 4.16
The Results of VIF

Variables	**Collinearity Statistics**	
	Tolerance	**VIF**
BSIZE	0.335	2.98
Crisis	0.823	1.21
FINCP	0.579	1.73
GDP	0.852	1.17
ICP	0.525	1.90
INTSU	0.744	1.34
ATMs	0.455	2.19
NPL	0.671	1.49
ROE	0.577	1.73
TYPE	0.597	1.67
FOR Banks	0.381	2.62
LPR Banks	0.446	2.24

4.6 Tobit Regression Results

We performed all regressions by using robust standard errors in order to control for heteroscedasticity as in Pasiouras (2008), Hauner (2005) and Saxonhouse (1976). We test the third objective stated previously in Chapter one by using Tobit regression with robust standard errors to examine the relationship between variables in this study. Regression results focusing on the relationship between bank efficiency and the explanatory variables, i.e., bank size, profitability, financial capital, non-performing loans, internationalization of banks, ATMs, type of banks, intellectual capital performance, foreign banks, local private banks, financial crisis and gross domestic product are presented in Table 4.17.

As depicted in Table 4.17, bank size (BSIZE) has a significant negative relationship at 5 percent significance level with scale efficiency. Thus, as predicted the hypotheses H1c of banks size are accepted for scale efficiency. This finding supports earlier studies, such as Hermalin and Wallace (1994) and Isik and Hassan (2002) that found a negative relationship between bank size and efficiency. On the other hand, bank size is found to have non-significant relationship with technical and pure technical efficiency. Thus, (H1a and H1b) are rejected. In the Yemen context regarding banks' operation, the observed negative association of efficiency with bank size indicates that economies of scale positively stimulate the production performance of small banks and negatively influence the large banks' efficiency.

Table 4.17
Tobit Censored Regression Results

Explanatory Variables	Model 1 (TE) (177 Obs)		Model 2 (PTE) (177 Obs)		Model 3 (SE) (177 Obs)	
	Coef.	**Prob.**	**Coef.**	**Prob.**	**Coef.**	**Prob.**
BSIZE	-0.112258	0.1848	0.097420	0.2680	-0.173395	0.0145 **
ROE	-0.436914	0.0742*	-0.176266	0.5620	-0.403186	0.0335 **
FINCP	0.007059	0.9863	0.261196	0.5585	-0.131862	0.6876
NPL	0.021021	0.8604	-0.249670	0.0774*	0.101114	0.2969
INTSU	0.357200	0.0000***	0.421735	0.0001 ***	0.144979	0.0043***
ATMs	-0.030890	0.3930	-0.079087	0.0688*	0.041937	0.1752
TYPE	0.207980	0.0001***	0.226976	0.0000***	0.067492	0.0938*
ICP	0.044846	0.0007***	0.022388	0.1008*	0.034713	0.0009 ***
FOR Banks	0.327529	0.0000***	0.560757	0.0000***	0.164260	0.0041***
LPR Banks	0.106832	0.0940*	-0.008897	0.9102	0.133049	0.0113**
Crisis	0.060814	0.2258	-0.028644	0.6112	0.041788	0.3111
GDP	0.010002	0.0122**	0.008835	0.1294*	0.008003	0.0184**
C	1.622971	0.0770*	-0.266140	0.7827	2.462504	0.0012 ***
Log likelihood	-31.41647		-30.98018		-6.137904	

Notes: * significant at 10% level, ** significant at 5% level, *** significant at 1% level. (TE), Technical efficiency; (PTE), Pure technical efficiency; (SE), Scale efficiency; (BSIZE), Bank size; (ROE), Profitability; (FINCP), Financial capital; (NPL), Non-performing loans; (INTSU), Internationalization of banks; (ATMs), Automated Teller Machines; (TYPE), Type of banks; (ICP), Intellectual capital performance; (FOR Banks), Foreign banks; (LPR Banks), Local private banks; (Crisis), Financial crisis; (GDP), Gross domestic product.

This implies that certain percentage of their productive inefficiency is likely due to inappropriate size. Another explanation for the negative association between bank size and efficiency comes from the fact that increase in banks size is a mean of supplementary costs and has a propensity of decreasing large banks' efficiency. In addition, because of their scale of operations which is small in a well-targeted market segment, small banks can be more effectively managed than their large counterparts.

Generally speaking, the finding of the relationship between bank size and efficiency is consistent and provides support to the divisibility theory which suggests no or a negative relationship between bank size and efficiency, suggesting that large banks have no operational advantage compared to small-scale banks.

In contrast to this study`s prediction, the relationships between bank profitability (ROE) and technical and scale efficiencies are found to be negatively significant at 10 percent significance level for Model 1 and at 5 percent significance level for Model 3. Thus, H2a as well as H2c are accepted. This finding is consistent with the findings of previous studies, such as Moussawi and Obeid (2011), Ataullah and Le (2006) and Casu and Girardone (2004). On the other hand, consistent with the prediction of this study, the relationship between bank profitability and pure technical efficiency is found to be insignificant. Thus, H2b is rejected.

The negative relationships between profitability (ROE) and technical and scale efficiencies could be attributed to the low level of competition in the banking sector in Yemen. According to Moussawi and Obeid (2011), banks that possess a reserve of profit or market power would have fewer incentives than others to increase their efficiency. According to Berger and Hannan (1998), in the case of presence of monopoly power as in markets with low competition, monopolists earn higher profits and given the absence of competitive pressures, are also characterized by a higher level of inefficiency. In the same vein, is found to have insignificant association with profitability (ROE). Generally speaking, if profitability of banks is not associated with higher efficiency, this might mean that the overall economic environments in which banks operate have a more

crucial influence on efficiency than bank profitability as well as skills of bank managers. In addition, the loose regulation and over-protection of banks in the area could provide explanation for the weak connection of efficiency with profitability.

The coefficients of financial capital (FINCP) have shown insignificant associations with the three components of efficiency in the three models. This finding is consistent with that reported by Havrylchyk (2006) and Reda and Isik (2006). Therefore, the hypotheses of financial capital and efficiency (H3a, H3b and H3c) are rejected. The insignificant association between FINCP and the three components of efficiency in the three models show that although average capitalization increased from 11 percent in 1998 to 16 percent in 2011, it does not have any influence on efficiency.

This insignificant impact of capitalization on bank efficiency indicates there is no difference between Yemeni banks that use high or less capitalization in terms of efficiency. This may be explained by saying owners are not involved in management decisions that are related to bank efficiency. It seems that owners of Yemeni banks are working as just investors and allow control over key aspects of banks to be retained by the mangers.

As shown in Table 4.17, the relationships between non-performing loans (NPL) and overall efficiency (technical and scale efficiencies) are negative, but not significant. Thus, H4a as well as H4c are rejected. This finding is consistent with that reported by Fan and Shaffer (2004). On the other hand, as predicted, non-performing loan is found to have a negative relationship at 10 percent with pure technical efficiency. Thus, H4b is

accepted. The insignificant relationships between technical, scale efficiencies, and NPL are not as expected and in contrast to the prediction of the bad management hypothesis. However, these findings are instructive because they suggest that these banks may require high loan guarantees up to 150 percent of the value of the loans. The significant negative relationship between NPL and pure technical efficiency is not surprising due to the fact Yemeni banks lack managerial skills (Al-Swidi and Mahmood, 2011). This finding is consistent with the bad management hypothesis that argues that poor management decisions that result from the lack to managerial skills is one of the key reasons of NPL.

With respect to internationalization of banks (INTSU) which refers to the international presence of banks through subsidiaries, it appears that the relationship is significant and positive impact on components of efficiency at 1 percent level for all models. Thus, the hypotheses (H5a, H5b and H5c) are accepted. This finding provides support to the eclectic theory which argues that banks which have an international presence may improve efficiency as this leads to economies of scale. This result is parallel with the common presumption shared in the literature that multi-national banks will be able to encounter lesser diseconomies and lower inefficiencies from joint production compared with the domestic banks, and fully exploit economies of scale (Isik & Hassan, 2002; Mahajan *et al*., 1996).

The empirical findings show that ATMs possess insignificant relationship with bank's efficiency in terms of technical and scale. Thus, the hypotheses of ATMs of banks and efficiency (H6a and H6c) are rejected. This finding is consistent with that found by

Pasiouras (2008). The insignificant relationship between ATM and technical and scale efficiencies could be attributed to Yemeni customers' preference to use personal contact rather than ATMs at branches. The continued rise in the number of bank branches in Yemen as stated in the CBY Annual Report (2011) is related to the rapid increase in retail banking and the continued preference of Yemen customers for transaction via the branches. Another explanation for the insignificant association between ATMs and efficiency may be due to the low education levels and low income in Yemen. As mentioned by Swinyard and Ghee (1987), ATM users tend to have higher level of education and income.

However, the relationship between pure technical efficiency and ATMs is significantly negatively related at 10 percent level. Thus, H6b is accepted. This implied that although banks have increase the number of ATMs and incur a huge installation cost, the Yemeni customers do not use the facilities appropriately. This may be due to the preference of the customers who would like to have personal contact rather than using the machine.

As depicted in Table 4.17, bank type (TYPE) has a significant positive with both technical and pure efficiency at a 1 percents level and scale efficiency at 10 percent level. Therefore, the hypothesis (H7) of the relationship between bank type and efficiency and its sub-hypotheses (H7a, H7b and H7c) are accepted. This result is consistent with findings of previous studies, such as Alsarhan (2009), Hussein (2004) and Al-Jarrah and Molyneux (2003). This finding implies that Islamic banks as compared to conventional banks are more efficient.

The higher efficiency of Islamic banks could be attributed to several factors, among them, the fact that Islamic banks are, on average, more profitable than conventional banks[4]. Presumably, this difference is due to risk. Islamic banks voluntarily hold more cash relative to deposits than conventional banks due to the risk of withdrawal of deposits (Olson & Zoubi, 2008). Also, Islamic banks are less affected by world financial crises, such as crisis of 2008, due to the nature of the Islamic banking system (Alsarhan, 2009).

To some extent, this finding raises questions with regards to whether the regulators in Yemen should encourage the conversion from the conventional banking to an entire Islamic banking system, similar to countries like Sudan and Iran (Solé, 2007). It appears that the adherence to Islamic Shariah principles would give Yemeni banks a competitive advantage over their foreign peers.

Regression results as shown in Table 4.17 reveal that intellectual capital performance (ICP) has positive association with overall efficiency, at a 1 percent significance level for both technical and scale efficiency and at 10 percent (one tail) significance level for pure technical efficiency of Yemeni banks. These findings suggest that banks with greater intellectual capital performance perform better in terms of efficiency. This result

[4] For example, the average profitability (ROE) of Tadhamon International Islamic Bank and Saba Islamic Bank are approximately 14% and 41% respectively during study period.

is consistent with findings of previous studies, such as Al-Musali *et al*. (2013), Ku Ismail and Abdul Karem (2011), as well as Mavridis and Kyrmizoglou (2005). This finding implies that intellectual capital performance has a positive impact on financial performance.

The aggregate results from regression Models 1, 2 and 3 assert that intellectual capital performance is a predictor of banks' efficiency in Yemen. Thus, the main hypothesis (H8) and its sub-hypotheses (H8a, H8b and H8c), that suggest the existence of a positive relationship between intellectual capital performance and efficiency of banks in Yemen are supported. The positive effect of ICP on bank efficiency supports the importance of ICP as a strategic asset of banks and indicates the urgent need to enhance investing in ICP resources to maintain the intellectual capital efficiency level in the long-run.

With regards to control variables, foreign bank (FOR Banks) is found to have significant positive association with technical, pure technical and scale efficiencies at 1 percent level. This result is consistent with findings of previous studies, such as Sufian (2009) and Reda and Isik (2006). The findings imply that banks with foreign ownership are likely to be more efficient compared to their domestic owned counterparts. This should be no surprise because of the ability of foreign owned banks to capitalize on their access to a better risk management and operational techniques, which is usually made available through their parent banks abroad.

Moreover, with regards to local private banks (LPR Banks) this study found a positive and statistically significant relationship with technical and scale efficiencies at 10

percent level and 5 percent level respectively. The higher efficiency of local private banks could be attributed to several factors. Private and public firms might have different objectives. Public banks are likely to pay special attention to political and social goals such as low output prices, employment or external effects which in turn may lead to politicizing resource allocation process that may lead to reduced efficiency and value of firms (Najid & Abdul Rahman, 2011; Tian & Estrin, 2008). In contrast to the private ownership that fosters firm efficiency via incentives and constraints provided by the market, public ownership reduces the incentives of public owners to monitor the performance of management.

With regards to global financial crisis, it is found that global financial crisis did not give any significant impact towards efficiency of banks in Yemen. This result is consistent with Hidayat and Abduh (2012). One possible reason, according to Central Bank of Yemen (CBY) is that the Yemeni economy in general and banking sector in particular have not been affected by the financial crisis, because the country did not have direct investments in the USA, and most of its investments were geographically distributed among the European countries.

Finally, economic growth is positive and statistically significant with both technical and scale efficiencies at 5 percent level, and with pure technical efficiency at 10 percent level (one tail). In the Yemeni context regarding banks' operation, the positive relationship of economic growth with efficiency is due to an increase in financial services demand and a decrease in payment defaults that accompanied economic growth. This apparently expected finding is consistent with the results obtained by Chan (2008) and Sufian and

Table 4.18

Summary of Testing Hypotheses Results Related to the Determinants of Efficiency

Hypotheses	**Variables (Expected sign)**	**Significant Variables based on the (TE) (PTE) (SE)**	**Decision**
Bank size H1)	No		
H1a	relationship	N/R	Rejected
H1b		N/R	Rejected
H1c		√(-)	Accepted
Profitability H2)	No		
H2a	relationship	√(-)	Accepted
H2b		N/R	Rejected
H2c		√(-)	Accepted
Financial capital H3)	No		
H3a	relationship	N/R	Rejected
H3b		N/R	Rejected
H3c		N/R	Rejected
Non-performing loans H4)	Negative		
H4a	relationship	N/R	Rejected
H4b		N/R	Accepted
H4c		N/R	Rejected
Internationalization of banks H5)	No		
H5a	relationship	√(+)	Accepted
H5b		√(+)	Accepted
H5c		√(+)	Accepted
Automated Teller Machines H6)	No		
H6a	relationship	N/R	Rejected
H6b		√(-)	Accepted
H6c		N/R	Rejected
Type of banks H7)	No		
H7a	relationship	√(+)	Accepted
H7b		√(+)	Accepted
H7c		√(+)	Accepted
Intellectual capital performance H8)	Positive		
H8a	relationship	√(+)	Accepted
H8b		√(+)	Accepted
H8c		√(+)	Accepted

Note: (TE), Technical efficiency; (PTE), Pure technical efficiency; (SE), Scale efficiency; (√), Denotes relationship among variables tested; (N/R), No relationship.

Abdul Majid (2007), where economic growth is reported to be positively related to efficiency.

4.7 Robustness Analysis

The robustness analysis is done in two ways. First, all independent variables which show insignificant associations with the dependent variables are excluded from the analysis; second, the possible determinants of the efficiency of banks are reinvestigated using a random effects Tobit model. Third, by substitution of the intellectual capital performance (ICP) variable with its components (i.e., Human capital efficiency [HCE] and Capital employed efficiency [CEE])[5].

4.7.1 Testing the Robustness of the Main Results by Exclusion of the Independent Variables that Show Insignificant Associations with the Dependent Variables

In order to check the robustness of the three main models, the independent variables that show insignificant association with the dependent variable are simultaneously excluded. The three models are then re-estimated. Table 4.19 shows that all insignificant variables (i.e., BSIZE, FINCP, NPL, ATMs and Crisis) are dropped for Models 1 and (i.e., BSIZE, ROE, FINCP, LPR Banks and Crisis) are dropped for Models 2 while FINCP, NPL, ATMs, FOR Banks and Crisis are dropped for Model 3. Table 4.19 shows similar results as in Table 4.17, except for GDP and TYPE in Model 3 and 1. The insignificant results of TYPE may be due to concurrent effect of (FINCP, NPL, ATMs, FOR Banks and

[5] The VAIC hypothesized by Pulic (1998a) is the summation of a business' employed capital efficiency (CEE), human capital efficiency (HCE) and structural capital efficiency (SCE). The SCE is an inverse function of the HCE. Furthermore, Pulic (1998a) states that HC is the root of a business' intellectual capital and its structural capital is the previous performance realized by its HC (i.e., organizational procedures, licenses, patents, company image, and customer relations). Thus, a sequence of studies (Mavridis, 2004a, 2004b; Mavridis, 2005) has made VAIC simpler into the summation of CEE and HCE.

Crisis) variables in the model. While the insignificant results of GDP may be due to concurrent effect of (i.e., BSIZE, ROE, FINCP, LPR Banks and Crisis) variables in the model.

Table 4.19
Robustness Tests to the Exclusion of the Independent Variables that Show Insignificant Association with the Technical, Pure Technical and Scale Efficiency (TE, PTE & SE) Scores

Explanatory Variables	**Model 1 (TE)**		**Model 2 (PTE)**		**Model 3 (SE)**	
	Coef.	**Prob.**	**Coef.**	**Prob.**	**Coef.**	**Prob.**
BSIZE	-	-	-	-	-0.132758	0.0114**
ROE	-0.576543	0.0090***	-	-	-0.545536	0.0015***
NPL	-	-	-0.261094	0.0336**	-	-
INTSU	0.256872	0.0000***	0.440681	0.0000***	0.156582	0.0029***
ATMs	-	-	-0.056666	0.0972*	-	-
TYPE	0.205986	0.0001***	0.217589	0.0000***	0.055607	0.1722
ICP	0.042839	0.0001***	0.022992	0.0161**	0.043068	0.0000***
FOR Banks	0.345648	0.0000***	0.571703	0.0000***	-	-
LPR Banks	0.128507	0.0155**	-	-	0.071568	0.0775*
GDP	0.013608	0.0001***	0.006289	0.2589	0.007844	0.0158**
C	0.430076	0.0000***	0.756320	0.0000***	2.132360	0.0001***
Log likelihood	-35.77176		-32.15901		-12.79123	

Notes: * significant at 10% level, ** significant at 5% level, *** significant at 1% level

The overall fit of the model is tested via the likelihood ratio test which in this context compares the model's likelihood with and without a specific variable. The log likelihood ratio (LR) test is conducted to test for the parameters employed. The LR test requires estimation of both the restricted and unrestricted parameter vectors. The log likelihood ratio statistics can be computed using Equation 4.1 below.

$$LR = 2(L_{ur} - L_r) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad 4.1$$

L_{ur} = log likelihood value for the unrestricted model

L_r = log likelihood value for the restricted model.

The L_{ur} can be obtained from the estimations of the Log likelihood from Models 1, 2 and 3 at Table 4.17 for the full sample. Whereas the L_r will be estimated by setting all insignificant variables slope parameters in Models 1, 2 and 3 at Table 4.17 to zero.

Table 4.20
Log Likelihood Ratio for Technical, Pure Technical and Scale Efficiencies

	Model 1 (TE)	**Model 2 (PTE)**	**Model 3 (SE)**
LR	8.71	2.36	4.04
Prob > chi2	0.1212	0.7978	0.4005

As show in Table 4.20 the null hypothesis is not rejected at the 5 percent level. Generally these findings suggest that BSIZE, ROE, FINCP, NPL, ATMs and Crisis of Model 1 did not provide incremental explanatory power over and above the influence of technical efficiency. The same is true for Models 2 and 3.

4.7.2 Robustness Tests by Using Tobit Random Effects Models (Panel Data) for Technical, Pure Technical and Scale Efficiencies.

The basic model is reexamined using Tobit Random effects Models (panel data) for Technical efficiency and its components. It is interesting to note that random effects models as reported in Table 4.21 partially change the result of the relationship between INTSU, TYPE, LPR BANKS and technical efficiency and its components reported earlier. In respect to the other variables, this study finds slightly different results from the

initial analysis. For example, FOR BANKS still has a significant positive association with technical efficiency but at a one percent significant level instead of 5 percent significant level. Results on the other variables are almost similar to the initial analysis.

Table 4.21
Tobit Random Regression Results

Explanatory Variables	**Model 1**		**Model 2**		**Model 3**	
	(TE)		**(PTE)**		**(SE)**	
	Coef.	**Prob.**	**Coef.**	**Prob.**	**Coef.**	**Prob.**
BSIZE	-0.041829	0.617	0.1015737	0.248	-0.1873418	0.020**
ROE	-0.4465608	0.052*	-0.153514	0.551	-0.4596782	0.021**
FINCP	-0.285011	0.461	0.2899037	0.506	-0.3692365	0.268
NPL	0.1128416	0.445	-0.235315	0.105*	0.1348774	0.378
INTSU	0.1327673	0.171	0.4139388	0.001***	0.0425969	0.648
ATMs	-0.0166416	0.671	-0.079632	0.053*	0.0462284	0.304
TYPE	0.1968905	0.000***	0.2284458	0.0000***	0.0793215	0.542
ICP	0.0331252	0.005***	0.0207742	0.113*	0.0314695	0.002***
FOR Banks	0.3556402	0.000***	0.5665683	0.0000***	0.2403915	0.018**
LPR Banks	0.0266891	0.721	-0.005428	0.941	0.1327428	0.372
Crisis	0.0642081	0.227	-0.027073	0.674	0.0564428	0.193
GDP	0.0108057	0.014 **	0.0087256	0.105*	0.0074458	0.037**
C	0.9890179	0.273	-0.315415	0.742	2.642159	0.003***
Log likelihood	-22.645892		-30.67154		1.0024811	

Notes: * significant at 10% level, ** significant at 5% level, *** significant at 1% level. (TE), Technical efficiency; (PTE), Pure technical efficiency; (SE), Scale efficiency; (BSIZE), Bank size; (ROE), Profitability; (FINCP), Financial capital; (NPL), Non-performing loans; (INTSU), Internationalization of banks; (ATMs), Automated Teller Machines; (TYPE), Type of banks; (ICP), Intellectual capital performance; (FOR Banks), Foreign Banks; (LPR banks), Local private banks; (Crisis), financial crisis; (GDP), Gross domestic product.

4.7.3 The Substitution of the Variable Intellectual Capital Performance (ICP) with its Components (i.e., Human Capital Efficiency [HCE] and Capital Employed Efficiency [CEE]).

Table 4.22 presents the results of technical efficiency, pure technical efficiency and scale efficiency when intellectual capital performance (ICP) is divided into its components, human capital efficiency (HCE) and capital employed efficiency (CEE).

Table 4.22 shows similar results as in Table 4.17. FINCP, NPL, INTSU, Crisis and GDP are similar to the main results as presented in Models 1, 2 and 3 of Table 4.17. Bank size (BSIZE) shows significant results at one percent level in Model 3 instead of 5 percent level in the initial analysis. Profitability (ROE) is also not significant in Model 1 and Model 3, whereas in the main model (Models 1 and 3 of Table 4.17), it is significant at the 10 percent and 5 percent levels, respectively. Type of banks (TYPE) shows insignificant relationship in Model 3, whereas in the main model, it is significant at the 10 percent level. Foreign banks (FOR Banks) show significant results at 5 percent in Model 3, whereas in the main model, it is significant at the 1 percent level. Local banks (LPR Banks) show insignificant results in Model 1 and significant at the 10 percent in Model 3, whereas in the main model, it is significant at the 10 percent and 5 percent levels, respectively.

With regards to human capital efficiency (HCE), the results show a significant positive relationship between human capital efficiency (HCE) and efficiency of banks in Yemen at 1 percent level in Models 1 and 3, while at 10 percent level in Model 2. With respect to capital employed efficiency, the results show an insignificant relationship between

capital employed efficiency (CEE) and efficiency of banks in Yemen for all three models. The comparison between HCE and CEE shows that HCE is the major contributor to the bank's intellectual capital performance.

Table 4.22
The Substitution of the Intellectual Capital Performance (ICP) with its Components (HCE & CEE)

Explanatory Variables	Model 1 (TE)		Model 2 (PTE)		Model 3 (SE)	
	Coef.	**Prob.**	**Coef.**	**Prob.**	**Coef.**	**Prob.**
BSIZE	-0.118094	0.1590	0.092316	0.2986	-0.178262	0.0133**
ROE	-0.313957	0.2617	-0.110654	0.7244	-0.314017	0.1516
FINCP	0.247310	0.6321	0.405708	0.4518	0.032832	0.9253
NPL	0.050563	0.6938	-0.226404	0.1298*	0.124253	0.2211
INTSU	0.416071	0.0000***	0.416071	0.0001***	0.136120	0.0098***
ATMs	-0.037028	0.2899	-0.083824	0.0446**	0.038175	0.2205
TYPE	0.193385	0.0003***	0.216502	0.0000***	0.058663	0.1313
HCE	0.055835	0.0007***	0.032436	0.0601*	0.041969	0.0011***
CEE	-2.718262	0.1792	-2.144243	0.2904	-1.731239	0.2699
FOR Banks	0.290570	0.0001***	0.523465	0.0000***	0.143821	0.0207**
LPR Banks	0.067026	0.3121	-0.042936	0.6038	0.108774	0.0612*
Crisis	0.058425	0.2464	-0.033677	0.5465	0.041292	0.3223
GDP	0.009488	0.0130**	0.007906	0.1608*	0.007720	0.0217**
C	1.749649	0.0554*	-0.159225	0.8708	2.553171	0.0010***
Log likelihood	-30.71335		-29.98689		-6.119648	

Notes: * significant at 10% level, ** significant at 5% level, *** significant at 1% level. (HCE), human capital efficiency; (CEE), capital employed efficiency.

The performance of Yemeni banks in terms of CEE has no impact on overall value creation efficiency of the banks. This finding is consistent with previous studies on

Yemeni Banks (Al-Musali *et al*., 2013), Bahraini banks (Ku Ismail & Abdul Karem, 2011), commercial banks in eight Asian countries (Young, Su, Fang and Fang, 2009), Indian banks (Kamath, 2007), Malaysian banks (Goh, 2005) and Japanese banks (Mavridis, 2004). Thus, as argued by Goh (2005), though physical capital is essential for banks to operate, human capital is the key determinant of the value creation process and ensuring the quality of services provided to customers.

This finding implies that managers of banks in Yemen must recognize their employees as the most important assets and their success in creating more value to their stakeholders is a function of the ability of their professionals relative to that of their counterparts in rival banks. As suggested by Young *et al*. (2009), argue that financial service firms must give training to their employees in order to develop their expertise. Katsanis (2006) points out those continuous training programs are a vital tool for employees' and managers' performance. Besides the common personnel practices, banks should consider encouraging employees' innovations.

The insignificant impact of capital employed on bank efficiency exhibits signs of redundant and nonperforming tangible resources, and suggesting the need for restructuring to increase value creation efficiency of capital employed. Banks in Yemen appear to be relying on human capital to improve bank efficiency.

4.8 Summary

This chapter examines the technical, pure technical and scale efficiencies of banking sector in Yemen by employing the two-stage method. In the first stage, the study uses the DEA approach to assess the efficiency level of banks operating in Yemen between 1998 and 2011. The results indicate that most Yemen banks are facing scale problems, especially due to decreasing returns to scale (DRS). The results also demonstrate that foreign banks are relatively more efficient than their counterparts (i.e., government banks and local banks) over the period. Moreover, the results based on bank type show that Islamic banks outperform their counterparts in all efficiency scores. The results also show that International banks have higher efficiency scores.

In the second stage, we used the Tobit regression model to regress the efficiency score obtained from the first stage on factors that could influence the efficiency score. The results suggest that higher efficiency levels are associated with internationalization of banks, type of bank, intellectual capital performance, foreign banks and gross domestic product. Other some variables (i.e., banks size, profitability, non-performing loans, ATMs and local private banks) have shown different and inconsistent associations with technical efficiency and its components. On the other hand, financial capital and financial crisis variables have shown no relationship with efficiency and its components at all. Further analyses which are carried out also show similar results. The next chapter summarizes the dissertation, shows implication and limitation of the study, and presents some recommendations for future researches.

CHAPTER FIVE

SUMMARY AND CONCLUSION

5.1 Introduction

This last chapter reflects on the results of the study, discusses the contributions and the limitations encountered in the course of conducting this study and makes suggestions for future studies. In this chapter, the summary of the overall results of this study are discussed in Section 5.2. The potential implications of the study are addressed in Section 5.3. Section 5.4 discusses research limitations and provides several possible avenues to explore for further research. Finally, Section 5.5 ends up with a conclusion.

5.2 Summary of the Study

The primary objective of this dissertation is to undertake an in-depth study on the efficiency of the banking system in Yemen using data envelopment analysis (DEA), a non-parametric approach, for the period from 1998 to 2011. The variables used in DEA model are chosen based on the intermediation approach. Under the intermediation approach, labor, capital and deposits are treated as the inputs for producing loans and investments as the outputs.

This study covers three research issues. First, we study the efficiency level of banks operating in Yemen during the period of study. Second, we analyze the efficiency level of banks with different identity (government banks, local private banks and foreign

banks), bank type and bank internationalization. Third, we identify whether factors, such as size, profitability, non-performing loans, financial capital, ATMs, type of banks, internationalization of banks, and intellectual capital performance determine efficiency level of banks in Yemen.

The importance of this study stems from the fact that the banking and financial sectors in Yemen will be facing serious challenges in the near future; this is because of the liberalization policy of the banking system which the Yemeni government has to follow in order to meet one of the requirements imposed by the WTO. The competition in the banking sector will become more intense as foreign banks are allowed to operate in the country. Hence, the ability of Yemeni banks to meet this challenge and to survive in a more competitive environment will depend on their level of efficiency. In other words, any inefficient bank will be forced out of the market by more efficient banks. To be able to meet these challenges, bank managers, as well as regulators, need to determine the level and sources of efficiency in the banking industry as an indicator of performance both of individual banks and of the industry as a whole.

Thus, the current study offers empirical evidence on the banking industry in Yemen which is so different from its counterparts in developed or even in developing countries in terms of quality of the introduced financial products and services, customer focus and banks' entrepreneurship. This study extends prior research on determinants of banks' efficiency by examining the impact of a set of explanatory variables that have not been addressed in previous studies, i.e., intellectual capital performance. By doing so, this

study complements the existing body of knowledge in bank efficiency from a least developing country perspective.

Results of this study show that the overall average technical efficiency (TE), pure technical efficiency (PTE) and scale efficiency (SE) for all banks over the sample period is 74.5 percent, 86.3 percent and 85.5 percent, respectively. The results indicate that most Yemen banks are facing scale problems especially due to decreasing returns to scale. Fifty-five percent of banks have been noted to be operating under the DRS and, hence, downsizing appears to be the right strategic option to decrease unit costs by these banks.

Results of this study show that there are significant differences in efficiency among banks operating in Yemen according to their identity, bank type and bank internationalization. The results demonstrate that foreign banks are relatively more efficient than government banks and local banks over the period from 1998 to 2011. Further analysis based on bank type show that when compared to conventional banks, Islamic banks are more efficient. Outperformance of Islamic banks over conventional banks may be due to the nature of Islamic banking transactions which are based on profit-sharing contracts, equity participation principle with depositors and other principles that are consistent with religious beliefs of employees. In the same vein, banks with higher levels of internationality have shown higher levels of efficiency compared to local banks. This could be attributed to the exploitation of scope or scale economies or new techniques and concepts ‘exported’ from abroad.

The third objective of the study examines the determining factors of banks' efficiency in Yemen. The variables used are bank size, profitability, non-performing loans, financial capital, ATMs, type of banks, internationalization of banks and intellectual capital performance. A total of 177 observations for Yemeni banks over the period 1998-2011 are used. A Tobit regression model is employed to test the hypotheses.

Finding from the regression analysis shows that efficiency (i.e., technical, pure technical and scale efficiencies) has a positive relationship with internationalization of banks, type of bank, intellectual capital performance, foreign banks and gross domestic product. On the other hand, the technical efficiency and its components have shown inconsistent associations with banks size, profitability, non-performing loans, ATMs and local private banks. In addition, financial capital and financial crisis do not show any significant relationship with technical, pure technical and scale efficiencies.

In addition, robustness tests are conducted to confirm the main results and to identify their consistency. These tests involve excluding the variables which showed insignificant associations with the dependent variables. In addition, this study reinvestigated the possible determinants of the efficiency of banks using a random effects Tobit model. Furthermore, the intellectual capital performance (ICP) is substituted by its components (i.e., Human capital efficiency [HCE] and Capital employed efficiency [CEE]). Except profitability, banks type and local private banks, the results are generally similar to the main results.

5.3 Implications of the Study

5.3.1 Implication to the Theory

One of the implications of the study is the introduction of one new variable, namely intellectual capital performance as a determinant for banks' efficiency and the variable is shown to be relevant. In addition, this study verifies the importance of a comprehensive set of variables that are found to be significant determinants for banks' efficiency in prior studies elsewhere. Moreover, divisibility, eclectic and resource-based theories are tested and supported in this study. On the other hand, shakeout and moral hazard theories are tested and not applicable in Yemen environment, bad management theory is partially supported.

5.3.2 Implication to the Policymakers

There are a number of important implications for policymakers arising from the results of this study. Government banks and local banks both have shown poor efficiency which is a cause for concern, as it is likely to constrain the growth and development of the financial sector in Yemen, and consequently the overall economy.

As a consequence, banking regulation and supervision should encourage government and local banks to focus on enhancing their efficiency through improving the quality of existing activities, improving management, and the upgrading of staff. In the long run, this could help government and local banks to improve their efficiency. Furthermore, the authorities ought to reconsider their reform and measures and try to stimulate more in dealing with the objective of competition in the marketplace in order to achieve the

desired efficiency in the financial sector of Yemen. There is implication for the evidence that lack of effective competition gives room for banks' inefficiency to continue and still remain in business. An important implication is that more policies which would promote competition are deemed very essential for the enhancement of banks' efficiency in Yemen. For instance, this may be realized if the number of foreign banks to operate in the economy is increased.

In addition, such reforms may include eliminating the distinction between government banks and other banks or reducing government control and interference in such banks. In addition, perhaps it would be helpful to such institutions to conduct their services in collaboration with the experts in other commercial banks. Besides that, domestic banks should be encouraged to compete in all sectors and segments of international financial markets so that they could achieve higher efficiency, resolve the problems of weak banks, improve the legal frameworks and enable information sharing among financial institutions on creditworthiness of borrowers.

These measures would help reduce operating costs and also encourage competition in the banking sector. To the extent that competition forces banks to operate more efficiently, this study calls for, among others, a need for the government in Yemen to put in place policies that could lessen banks' dependency on government securities as a basis of low-risk, and high-yield assets. This might likely result in high competition since banks would have to explore new opportunities for lending and enlarge their customer base so as to generate income. In addition, efficiency in the banking systems may be enhanced by strengthening technology like complete computerization of the banking systems. This

may make it possible for banks to offer a large quantity of products and services at competitive costs with improved practices of risk management.

Similar to previous studies that found Islamic Shariah compliant banks have higher efficiency compared to their counterparts (e.g., Alsarhan, 2009; Hussein, 2004; Al-Jarrah & Molyneux, 2003), the present study finds Islamic banks to be more efficient than their conventional counterparts. It would be useful if the government of Yemen adopts policies that encourage traditional banks to change their system to the Islamic system or, alternatively, establish Islamic branches as well as allowing more licenses for new Islamic banks.

Furthermore, due to the positive impact of bank internationalization on its efficiency that is found in this study, it would be useful if the Central Bank of Yemen adopts policies that encourage domestic banks to consider doing their operations in other countries as they may be able to exploit scale economies with the expansion of operations to new markets.

In addition, the positive impact of the real GDP growth rate serves as an essential signal to the policy makers that efficiency of banks can be enhanced when the economy is stable. Hence, the policy makers should make sure that the country attains a mature and stable economy so as to improve the banks' level of efficiency.

5.3.3 Implication for Managers

The results presented in this study could be useful to management who is concerned with improving efficiency of their banks. It should create awareness among management of the importance of bank specific characteristics in enhancing/limiting bank efficiency. Findings of this study provide information about bank specific characteristics that significantly affect efficiency of Yemeni banks. These characteristics should be considered by the management if it intends to improve bank efficiency. Owners, depositors and creditors may also find the results of this study to be of value.

Due to the critical role of intellectual capital performance in determining bank efficiency as revealed in this study, the findings serve as a wake-up call for Yemeni managers as well as policy makers to educate their human capital. The findings would suggest that management should consider using VAIC to control and manage their intellectual capital and to benchmark it against their rivals in a dynamic environment. This could help to formulate and implement policies for establishment of a resilient banking sector.

5.3.4 Implications for Academic Researchers

The results presented in this study could be useful to academic researchers studying bank efficiency worldwide. This study provides evidence that bank specific characteristics and intellectual capital performance play important roles in determining bank efficiency. It would be worthwhile to extend the study to other markets in the future, especially in emerging markets.

5.4 Limitations of Study and Future Research

The findings of this study are constrained by some limitations. First, the sample in this study is restricted to only banks; all non-financial related firms are excluded as they are regulated by different Acts. Hence, the outcomes from this study cannot be generalized to these institutions. In addition, this study covers only a particular period of time (i.e., from 1998 to 2011) which represents the post-liberalization period of banking sector. Therefore, this study does not cover the pre-liberalization period of banking sector before 1998 due to unavailability of data. Due to limitations to the data accessibility and transparency within the banking sector in Yemen, this study does not examine other variables that may affect bank efficiency, such as corporate governance variables.

Nevertheless, the above limitations highlight room for improvement in future bank efficiency studies. Extension to the current study is possible in the following areas:

1. The present study focuses only on the internal determinants of bank efficiency and ignores other external determinants associated with political and economic environments.
2. The current study also pays attention to the estimation of technical, pure technical and scale efficiencies so as to get efficiency scores for Yemeni banks from year 1998 to 2011. However, estimation associated with cost and profit efficiencies is excluded. Therefore, it could be useful to conduct further analyses on the level of cost and profit efficiency of Yemeni banks.
3. This study could be replicated in institutional environments having characteristics similar to that of the present study. Perhaps, replicating this study in such

countries can provide more powerful tests of the relationships examined in the study.

4. Future studies could conduct a comparative analysis, for example between Yemen banks and other sectors within Yemen or between Yemen and another nation.
5. Another direction for future research is that it would also be useful to evaluate the banks that change from traditional to Islamic banking or via opening Islamic windows. Such an evaluation can be carried out by estimating the efficiency level of those banks for the periods before and after the change, and then comparing between those periods.
6. Finally, as noted by previous studies as well as the present study, incomplete archival databases is one of main obstacles to conduct further studies in efficiency issues of the banking sector in Yemen. Hence this study strongly recommends that the banking sector should have a complete database, for further research.

5.5 Summary

This chapter outlines the main concluding remarks from this study. It presents the objectives, the summary methodologies, the empirical findings and how these findings contribute to the current streams of literature in banking efficiency. The implication, limitation and suggestion for future studies emanating from the current research are outlined.

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